Contents contains pages for

Operating Manual

for

RF and MICROWAVE TEST SETS

6200A SERIES

Part number 46882-106P
Issue 10

Creation date 13-Dec-94

Please open and fit to the supplied Ring Binder

MP MASTER
MA25817

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RF and MICROWAVE TEST SETS

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CUSTOMER QUESTIONNAIRE

Please spare a moment to detach, complete and return the Questionnaire on the next page. Your comments and suggestions will help us improve our products.

If you have had any problems with this product, please contact our Customer Support Help Desk on 0582-33866 at Luton if you are in the UK, or your Local Service Centre if outside the UK. The address and telephone number of your Local Service Centre is listed in this manual.

Please put the completed form in the addressed envelope provided and mail.

End User details

Name		
Company Name		
Company Address		
Country	Post Code	Fax no.
	Telephone No	Ext.

Equipment details

Part nos	Serial nos	Software Issues
Name & Address of Purchaser (if different from above)		
Delivery Date	Do you have a Maintenance Contract?	☐ Yes ☐ No

Equipment Condition

Was the equipment in perfect working order when delivered? ☐ Yes ☐ No

If the answer to the above question was 'no', was the problem to do with

- mechanical condition (damaged case etc.) ☐
- suspected hardware fault ☐
- suspected software fault ☐
- did not meet its specification. ☐

Please tick the relevant item and describe below;

(continue in blank space on previous page if necessary)

Severity

- Critical ☐
- Major ☐
- Minor ☐

Repeatable?

- Yes ☐
- No ☐
- Occasionally ☐

Claim under Guarantee

If you have had problems,

have you already claimed under the Guarantee ☐ Yes ☐ No

or do you intend to claim under Guarantee? ☐ Yes ☐ No

Improvements

We should like to receive any suggestions for improvements or applications of this or other products that you may have. Please add them below or include them on an extra sheet.

(continue in blank space on previous page if necessary)

Marconi Instruments Action

	Initial/Date		Initial/Date		Initial/Date
Copy to Comm. Admin.		Distributor contacted		Problem established	
Service Dept response		Follow through needed		Cleared	

RF and MICROWAVE TEST SETS

6200A SERIES

Includes information on 6200 Series Microwave Test Sets and 6210 Reflection Analyzer

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ASSOCIATED PUBLICATIONS

GPIB Operating Manual for the 6200A Series Microwave Test Set
Getting Started Manual for the 6200A Series Microwave Test Set

SUPPLEMENTARY INFORMATION FOR INSTRUMENTS WITH CRT DISPLAYS

The information in this manual applies to the current version of the Microwave Test Set, which has an LCD display. Earlier instruments (6200 Series) were fitted with CRT displays, but may have been upgraded with the current version of operating software. Relevant information for CRT instruments is included here, so that one manual can be used to cover both LCD and CRT versions of the MTS.

General

The manual contains references to 6200A Series instruments and LCD displays; these should be read as 6200 Series and CRT display for instruments fitted with CRTs. Similarly, figures will show the 6200A Series MTS, not the 6200 version.

Chapter 1 - General Information

Performance Data

Display Type	Colour display with 15 cm (6 in) visible diagonal. External colour monitor output available on rear panel.
External Monitor Output	Output to a variable scan rate colour monitor (see below). Rear panel 15 way "high density" D-type female connector.
Horizontal sync frequency	24.77 kHz nominal
Vertical sync frequency	54.9 Hz nominal
Horizontal sync width	3.5 µs nominal
Vertical sync width	204 µs nominal

Weight

6200	19 kg (41.7 lb)
6201	18 kg (39.5 lb)
6203	19.5 kg (42.8 lb)
6204	20 kg (43.9 lb)

Associated Equipment

The following variable scan rate monitors are recommended for use with the 6200 Series MTS, since they are known to operate satisfactorily with the instrument.

Mitsubishi FA3415 ETKL
Sony CPD 1402E
Taxan 770 Plus

Display Set-up Menu

The *[Screen Timeout]* and *[Screen Brightness]* soft keys described in the Display Set-up menu (accessed via the [UTILITY] key) are replaced with the following:

Colour Display — Sets the instrument to provide a colour display.

Monochrome Display — Sets the instrument to provide a green monochrome display.

Set Display Contrast — Used to set the contrast of the display by changing the contrast value, using the rotary control, step keys or numeric pad.

Test Display Menu

This menu is only available for CRT instruments, and is accessed by pressing

[UTILITY] *[Service] [Tests] [Test Display]*

The menu provides a means of checking that the CRT display is functioning correctly. It can also be used during servicing for setting up and adjusting the display.

Set Up Screen — Provides a test pattern which allows the geometry and convergence of the display to be checked.

Colour Bars — Provides vertical colour bars to check that colours are displayed correctly.

Crosshatch — Provides a grid of horizontal and vertical lines which enables screen linearity to be checked.

Greyscale — Provides a gradual greyscale along the width of the display, which allows the background brightness to be set and also help diagnose faults in the colour processing circuits.

Cycle Greyscale — Provides a monochrome display of gradually changing brightness, with either the R, G or B gun turned fully on and the other two turned fully off. Pressing this soft key cycles between the R, G or B displays and the greyscale as described above.

Remove Menu — Removes the soft key menu from the display so that the test pattern occupies the entire screen. Pressing any soft key restores the menu.

Exit — Terminates the display test.

Chapter 4 - Technical Description

6200A Series instruments have an LCD Interface board which drives the LCD module. This board is not present in 6200 Series instruments; the CRT display module is driven directly from the video driver stage on the Analogue board.

GPIB Operating Manual

The following GPIB command replaces :SYSTem:DISPlay:LCD\? in the SYSTem subsystem of the MTS command set.

:SYSTem
:DISPlay
:MONochrome

Parameters: <BOOLEAN PROGRAM DATA>
state

Description: Set either colour or monochrome display.

Example: `:SYST:DISP:MON ON`
Enable monochrome display mode.

Example: `:SYST:DISP:MON OFF`
Return to a colour display.

:SYSTem
:DISPlay
:MONochrome?

Parameters: [<BOOLEAN PROGRAM DATA>]
[state]

Response: <BOOLEAN RESPONSE DATA>
state

Example: `:SYST:DISP:MON?`
Determine whether instrument is displaying in colour or monochrome.

CONVENTIONS

The following conventions apply throughout this manual:

(1)	Sequence of steps in a procedure.
●	List of topics or items.
CAPS	Capitals are used to identify names of controls and panel markings, or system functions where no direct reference to an associated key is intended.
[CAPS]	Capitals in square brackets indicate hard key titles.
[Italics]	Italics in square brackets indicate soft key titles.

SOFTWARE STATUS

The operating software for this instrument is contained in EEPROMs fitted inside the unit. The software issue number can be determined by pressing [UTILITY]*[Service][Status][Display Build State]*.

WARNINGS, CAUTIONS and NOTES

These terms have specific meanings in this manual:

WARNINGS contain information to prevent personal injury.
CAUTIONS contain information to prevent damage to the equipment.
Notes contain important general information.

HAZARD SYMBOLS

The meaning of hazard symbols appearing on the equipment is as follows:

Symbol	Nature of hazard	Reference in manual
	Dangerous voltage	Page vi
	Beryllia	Page vii
	Static sensitive component	Page viii
	Fire hazard	Page vii
	Heavy instrument	Page vii
	Lithium batteries are used in this equipment. Appropriate caution should be exercised when handling these items	Page vii
	This is a general warning which appears whenever care is necessary to prevent damage to the equipment, a typical example being the front panel precision connector.	Page viii

SAFETY

This product has been designed and tested in accordance with BS4743 'Specification for safety requirements for electronic measuring apparatus' and IEC Publication 348 'Safety requirements for electronic measuring apparatus'.

WARNING - ELECTRICAL HAZARDS

AC supply voltage

This equipment conforms with IEC Safety Class 1, meaning that it is provided with a protective grounding lead. To maintain this protection the mains supply lead must always be connected to the source of supply via a socket with a grounding contact.

Be aware that the supply filter contains capacitors that may remain charged after the equipment is disconnected from the supply. Although the stored energy is within the approved safety requirements, a slight shock may be felt if the plug pins are touched immediately after removal.

Fuses

Note that there are supply fuses in both the live and neutral wires of the supply lead. If only one of these fuses should rupture, certain parts of the equipment could remain at supply potential.

Removal of covers

Disconnect the supply before removing the covers so as to avoid the risk of exposing high voltage parts. If any internal adjustment or servicing has to be carried out with the supply on, it must only be performed by a skilled person who is aware of the hazard involved.

WARNING - FIRE HAZARD

Make sure that only fuses of the correct rating and type are used for replacement.

If an integrally fused plug is used on the supply lead, ensure that the fuse rating is commensurate with the current requirements of this equipment. See under 'Performance Data' in Chapter 1 for power requirements.

WARNING - HEAVY INSTRUMENT

The 6200 Series MTS or 6200A Series MTS fitted with a 6210 exceeds the 18 kg (40 lb) guideline for manual handling by a single person. To avoid the risk of injury, an assessment should be carried out prior to handling which takes account of the load, workplace environment and individual capability, in accordance with European Directive 90/269/EEC and associated National Regulations.

WARNING - OTHER HAZARDS

Some of the components used in this equipment include resins and other chemicals which give off toxic fumes if incinerated. appropriate precautions should therefore be taken in the disposal of these items.

Beryllia

Beryllia (beryllium oxide) is used in the construction of some of the components in this equipment. This material, if incorrectly handled, could cause a danger to health - refer to the Maintenance part of the Service Manual for safe handling precautions.

Lithium battery

A Lithium battery (or a Lithium battery contained within an IC) is used in this equipment.

As lithium is a toxic substance, the battery should in no circumstances be crushed, incinerated or disposed of in normal waste.

If the battery is rapidly charged or discharged, there is a risk of explosion. Take care therefore to avoid short-circuiting it.

The following warning only applies to 6200 Series instruments (i.e. cathode ray tube displays):

WARNING - CATHODE RAY TUBE

When exposing or handling the tube, take care to prevent implosion and possible scattering of glass fragments. Handling should only be carried out by experienced personnel and the use of a safety mask and gloves is recommended. A defective tube should be disposed of in a safe manner by an authorized waste contractor.

CAUTION - PRECISION CONNECTOR

The precision connectors fitted to this equipment may be damaged by mating with a non-precision type. Damage to the connectors may also occur if the connector interface parameters are not within specification. This should be checked with an appropriate gauging tool. Refer to Chapter 2 for further information on connector care.

CAUTION - CALIBRATION KIT HANDLING PRECAUTIONS

The calibration kit used for reflection analyzer measurements requires special handling precautions to be observed. Refer to Appendix E for full details.

CAUTION - STATIC SENSITIVE COMPONENTS

This equipment contains static sensitive components which may be damaged by handling - refer to the Maintenance manual for handling precautions.

WARNING - TILT FACILITY

When the instrument is in the tilt position, it is inadvisable, for stability reasons, to stack other instruments on top of it.

CAUTION - CLEANING OF LCD WINDOW

The LCD window should be cleaned by wiping a slightly damp, soft, lint-free cloth gently over the surface. To remove grease or smears, use a clean cotton cloth moistened with Heptane. No other cleaning agents should be used. Clean the window using either horizontal or vertical strokes, NEVER a circular action.

CAUTION - CLEANING OF CRT SCREEN (6200 Series instruments)

The CRT display is fitted with a contrast enhancing filter, which should not be cleaned with alcohol-based cleaning fluids. Household cleaners (ammonia-based) are suitable.

PRECAUTIONS

WARNINGS, CAUTIONS and NOTES

Les termes suivants ont, dans ce manuel, des significations particulières:

WARNINGS contient des informations pour éviter toute blessure au personnel.
CAUTIONS contient des informations pour éviter les dommages aux équipements.
Notes contient d'importantes informations d'ordre général.

SYMBOLES SIGNALANT UN RISQUE

La signification des symboles liés à cet équipement est la suivante:

Symbole	Nature du risque	Référence dans le manuel
	Tension dangereuse	Page ix
	Beryllia	Page x
	Risque lié au feu	Page x
	Instrument lourd	Page x
	Piles au Lithium utilisées dans cet équipement. Des précautions particulières son à prendre lors de la manipulation de ces composants.	Page x

SECURITE

Cet appareil a été conçu et testé conformément aux normes BS4743 "Spécifications des conditions de sécurité pour instruments de mesure électronique" et CEI Publication 348 "Conditions de sécurité pour instruments de mesure électronique".

WARNING - SECURITE ELECTRIQUE

Tension d'alimentation alternative

Cet appareil est protégé conformément à la norme CEI de sécurité class 1, c'est-à-dire que sa prise secteur comporte un fil de protection à la terre. Pour maintenir cette protection, le cable d'alimentation doit toujours être branché à la source d'alimentation par l'intermédiaire d'une prise comportant une borne terre.

Notez que les filtres d'alimentation contiennent des condensateurs qui peuvent encore être chargés lorsque l'appareil est débranché. Bien que l'énergie contenue soit conforme aux exigences de sécurité, il est possible de ressentir un léger choc si l'on touche les bornes sitôt après débranchement.

Fusibles

Notez qu'il y a deux fusibles, l'un pour la phase et l'autre pour le neutre du cable d'alimentation. Si un seul fusible est coupé, certaines parties de l'appareil peuvent rester au potentiel d'alimentation.

Retrait des couvercles

L'appareil doit être débranché avant de retirer les couvercles afin d'éviter tout contact avec les éléments haute tension. Si toutefois un réglage interne ou une réparation nécessitent la présence de l'alimentation, ils devront être effectués par une personne qualifiée et avisée des risques encourus.

WARNING - RISQUE LIE AU FEU

Lors du remplacement des fusibles vérifiez l'exactitude de leur type et de leur valeur.

Si le cable d'alimentation comporte une prise avec fusible intégré, assurez vous que sa valeur est compatible avec les besoins en courant de l'appareil. Pour la consommation, reportez-vous au Chapitre 1 "Spécifications".

WARNING - INSTRUMENT LOURD

Les systèmes de test hyperfréquence séries 6200 et 6200A équipés du 6210, ont un poids supérieur à la limite de 18 kg (40 lb), fixée pour le transport par une seule personne. Afin d'éviter tout risque de blessure, il est nécessaire de faire, avant le transport, une évaluation de la charge, des contraintes de l'environnement et des capacités de l'individu, en conformité avec la Directive Européenne 90/269/EEC ainsi que les recommandations Nationales concernées.

WARNING - AUTRES RISQUES

Certains composants utilisés dans cet appareil peuvent contenir des résines et d'autres matières qui dégagent des fumées toxiques lors de leur incinération. Les précautions d'usages doivent donc être prises lorsqu'on se débarrasse de ce type de composant.

Le beryllia

Le Beryllia (oxyde de Beryllium) entre dans la composition de certains composants de cet appareil. Cette matière peut représenter un danger pour la santé s'il elle n'est pas manipulée de façon correcte - se référer à la partie "Maintenance" du "Manuel de Maintenance" pour les précautions de manipulation.

Lithium

Une pile au Lithium ou un CI contenant une pile au Lithium est utilisé dans cet équipement.

Le Lithium est une substance toxique; en conséquence on ne doit l'écrase, l'incinérer ou la jeter dans la "poubelle".

Ne pas essayer de la recharger, ne pas la court-circuiter, une forte décharge rapide risque de provoquer une surchauffe voire l'explosion de celle-ci.

L'avertissement suivant concerne les instruments de la série 6200 (c'est-à-dire avec écran cathodique).

WARNING - TUBE CATHODIQUE

Lorsque le tube cathodique est exposé ou manipulé, il convient de faire très attention aux risques d'implosion ou de projection de fragments de verre. Seul un personnel expérimenté doit faire ces manipulations et il est recommandé d'utiliser un masque de sécurité et des gants. Un tube défectueux doit être cédé, avec précautions, à une entreprise spécialisée dans le traitement de ce type de déchets.

WARNING - POSITION INCLINEE

Lorsque l'appareil est dans une position inclinée, il est recommandé, pour des raisons des stabilité, de ne pas y empiler d'autres appareils.

VORSICHTSMASSNAHMEN

WARNINGS, CAUTIONS and NOTES

Diese Hinweise haben eine bestimmte Bedeutung in diesem Handbuch:

WARNINGS	dienen zur Vermeidung von Verletzungsrisiken.
CAUTIONS	dienen dem Schutz der Geräte.
Notes	enthalten wichtige Informationen.

GEFAHRENSYMBOLE

Die Gefahrensymbole auf den Geräten sind wie folgt:

Symbol	Gefahrenart	Im Handbuch
	Gefährliche Spannung	Seite xi
	Beryllium	Seite xii
	Feuergefährlich	Seite xii
	Schweres Gerät	Seite xii
	Lithium Batterien - Vorsicht bei Austausch o.ä.	Seite xii

SICHERHEIT

Dieses Gerät wurde in Übereinstimmung mit BS4743 und IEC 348 entwickelt und geprüft.

WARNING - ELEKTRISCHE SCHLÄGE

Wechselspannungsversorgung

Das Gerät entspricht IEC Sicherheitsklasse 1 mit einem Schutzleiter nach Erde. Das Netzkabel muß stets an eine Steckdose mit Erdkontakt angeschlossen werden.

Filterkondensatoren in der internen Spannungsversorgung können auch nach Unterbrechung der Spannungszuführung noch geladen sein. Obwohl die darin gespeicherte Energie innerhalb der Sicherheitsmargen liegt, kann ein leichter Spannungsschlag bei Berührung kurz nach der Unterbrechung erfolgen.

Sicherungen

Es ist zu beachten, daß es Sicherungen in beiden (spannunsführenden und neutralen) Zuleitungen gibt. Wenn nur eine von diesen Sicherungen schmilzt, so bleiben einige Geräteteile immer noch auf Spannungspotential.

Abnahme von Abdeckungen

Die Spannungsversorgung muß vor Abnahme von Gehäuseabdeckungen unterbrochen sein, damit hochspannungsführende Teile gefahrlos zugänglich sind. Falls Abgleiche oder Servicearbeiten unter Spannung notwendig werden, dürfen solche Arbeiten nur von fachkundigem Personal durchgeführt werden, das die Gefahren kennt.

WARNING - FEUERGEFAHR

Es dürfen nur Ersatzsicherungen vom gleichen Typ mit den korrekten Spezifikationen entsprechend der Stromaufnahme des Gerätes verwendet werden. Siehe hierzu die Leistungsdaten (Performance Data) in Kapitel 1.

WARNING - SCHWERES GERÄT

Zusammen mit einem 6210 Pack liegt das Gewicht von Geräten der Serie 6200 MTS oder 6200A MTS über der 18 kg (40 lb) Grenze für Transport durch eine einzelne Person. Zur Vermeidung von Verletzungen sollten vor einem Transport die Arbeitsumgebung und die persönlichen Möglichkeiten im Verhältnis zur Last abgewogen werden, wie in der EU-Regelung 90/269/EEC und nationalen Normen beschrieben.

WARNING - ANDERE GEFAHREN

In einigen Bauelementen dieses Geräts können Epoxyharze oder andere Materialien enthalten sein, die im Brandfall giftige Gase erzeugen. Bei der Entsorgung müssen deshalb entsprechende Vorsichtsmaßnahmen getroffen werden.

Beryllium Oxid

Beryllium Oxid wird in einigen Bauelementen verwendet.

Bei inkorrekter Handhabung kann dieses Material Gesundheitsschäden verursachen. Siehe hierzu die Hinweise zur Handhabung im Service-Handbuch.

Lithium

Eine Lithium Batterie oder eine Lithium Batterie innerhalb eines IC ist in diesem Gerät eingebaut.

Da Lithium ein giftiges Material ist, sollte es als Sondermüll entsorgt werden.

Diese Batterie darf auf keinen Fall geladen werden. Nicht kurzschließen, da sie dabei überhitzt werden und explodieren kann.

Der folgende Hinweis bezieht sich nur auf Meßgeräte der Serie 6200 (.d.h. mit Kathoden-Strahlröhren).

WARNING - KATHODENSTRAHLRÖHREN

Bei Handhabung der Röhre ist auf Implosion und Glasbruch zu achten. Das Fachpersonal sollte dabei Sicherheitsmasken und Handschuhe tragen. Eine fehlerhafte Röhre sollte von einem autorisierten Fachbetrieb entsorgt werden.

WARNING - SCHRÄGSTELLUNG

Bei Schrägstellung des Geräts sollten aus Stabilitätsgründen keine anderen Geräte darauf gestellt werden.

PRECAUZIONI

WARNINGS, CAUTIONS and NOTES

Questi termini vengono utilizzati in questo manuale con significati specifici:

WARNINGS riportano informazioni atte ad evitare possibili pericoli alla persona.
CAUTIONS riportano informazioni per evitare possibili pericoli all'apparec-chiatura.
Notes riportano importanti informazioni di carattere generale.

SIMBOLI DI PERICOLO

Significato dei simboli di pericolo utilizzati nell'apparato:

Simbolo	Tipo di pericolo	Riferimento nel manuale
	Tensione pericolosa	Pagina xiii
	Berillio	Pagina xiv
	Pericolo d'incendio	Pagina xiv
	Strumento pesante	Pagina xiv
	Batterie al litio. Opportune precauzioni devono essere prese prima di maneggiarle.	Pagina xiv

SICUREZZA

Questo prodotte è stato progettato e provato secondo le norme BS4743 "Specification for safety requirements for electronic measuring apparatus" e la pubblicazione IEC 348 "Safety requirements for electronic measuring apparatus".

WARNING - PERICOLI DA ELETTRICITÀ

Alimentazione c.a.

Quest' apparato è provvisto del collegamento di protezione di terra e rispetta le norme di sicurezza IEC, classe 1. Per mantenere questa protezione è necessario che il cavo, la spina e la presa d'alimentazione siano tutti provvisti di terra.

Il circuito d'alimentazione contiene dei filtri i cui condensatori possono restare carichi anche dopo aver rimosso l'alimentazione. Sebbene l'energia immagazzinata è entro i limiti di sicurezza, purtuttavia una leggera scossa può essere avvertita toccando i capi della spina subito dopo averla rimossa.

Fusibili

Notare che entrambi i capi del cavo d'alimentazione sono provvisti di fusibili. In caso di rottura di uno solo dei due fusibili, alcune parti dello strumento potrebbero restare sotto tensione.

Rimozione dei coperchi

Prima di rimuovere i coperchi occorre scollegare la spina d'alimentazione onde evitare il rischio di esposizione di parti ad alta tensione. Eventuali operazioni di manutenzione che richiedono la presenza dell'alimentazione dovranno essere eseguite solo da parte di personale specializzato ed a conoscenza dei pericoli coinvolti.

WARNING - PERICOLO D'INCENDIO

Assicurarsi che, in caso di sostituzione, vengano utilizzati solo fusibili della portata e del tipo prescritto.

Se viene usata una spina con fusibili, assicurarsi che questi siano di portata adeguata coi requisiti di alimentazione richiesti dallo strumento. Tali requisiti sono riportati nel cap. 1 "Performance data".

WARNING - STRUMENTO PESANTE

Ciascun MTS della serie 6200 o 6200A corredato dell'opzione 6210 supera il peso limite di 18kg raccomandato per il trasporto manuale da parte di una singola persona. Per evitare rischi di danni fisici è bene quindi considerare il carico complessivo, le condizioni del trasporto e le capacità individuali in accordo con la direttiva comunitaria 90/269/EEC e con eventuali regolamenti locali.

WARNING - ALTRI PERICOLI

Alcuni dei componenti usati in questo strumento possono contenere resine o altri materiali che, se bruciati, possono emettere fumi tossici. Prendere quindi le opportune precauzioni nell'uso di tali parti.

Berillio

Berillio (ossido di berillio) è utilizzato nella costruzione di alcuni componenti di quest'apparato.

Questo materiale, se maneggiato non correttamente, può causare danni alla salute. Far riferimento ai capitoli di manutenzione del Manuale di Servizio per le precauzioni richieste.

Litio

Quest'apparato incorpora una batteria al **litio** o un circuito integrato contenente una batteria al **litio.**

Poiché il litio è una sostanza tossica, la batteria non deve essere mai né rotta, né incenerita, né gettata tra i normali rifiuti.

Questo tipo di batteria non può essere sottoposto né a ricarica né a corto-circuito o scarica forzata. Queste azioni possono provocare surriscaldamento, fuoriuscita di gas o esplosione della batteria.

Il seguente avviso è da riferirsi solo agli strumenti della serie 6200 (tubo a raggi catodici).

WARNING - TUBO A RAGGI CATODICI

Fare attenzione nell'esporre o nel maneggiare il tubo per evitare implosioni ed il lancio dei frammenti di vetro. I tubi dovrebbero essere maneggiati solo da personale specializzato ed usando guanti ed occhiali di sicurezza. Un eventuale tubo difettoso va eliminato tramite ditte specializzate.

WARNING - POSIZIONAMENTO INCLINATO

Quando lo strumento è in posizione inclinata è raccomandato, per motivi di stabilità, non sovrapporre altri strumenti.

PRECAUCIONES

WARNINGS, CAUTIONS and NOTES

Estos términos tienen significados específicos en este manual:

WARNINGS	contienen información referente a prevención de daños personales.
CAUTIONS	contienen información referente a prevención de daños en equipos.
Notes	contienen información general importante.

SÍMBOLOS DE PELIGRO

Los significados de los símbolos de peligro que aparecen en los equipos son los siguientes:

Símbolo	Naturaleza del peligro	Referencia en manual
	Voltaje peligroso	Pagina xv
	Berilio	Pagina xvi
	Peligro de 'incendio	Pagina xvi
	Instrumento pesado	Pagina xvi
	Utiliza baterías de Litio. Debe de aplicarse cuidados especiales al manipularlas	Pagina xvi

Seguridad

Este producto ha sido diseñado y probado según las normas, BS4743 'Especificaciones de los requisitos de seguridad para instrumentos electrónicos de medida ' e IEC publicación 348 'Requisitos de seguridad para instrumentos electrónicos de medida'.

WARNING - NIVEL PELIGROSO DE ELECTRICIDAD

Tensión de red

Este equipo cumple las normas IEC Seguridad Clase 1, lo que significa que va provisto de un cable de protección de masa. Para mantener esta protección, el cable de alimentación de red debe de conectarse siempre a una clavija con terminal de masa.

Tenga en cuenta que el filtro de red contiene condensadores que pueden almacenar carga una vez desconectado el equipo. Aunque la energía almacenada está dentro de los requisitos de seguridad, pudiera sentirse una ligera descarga al tocar la clavija de alimentación inmediatamente después de su desconexión de red.

Fusibles

Se hace notar que el Equipo está dotado de fusibles tanto en el activo como el neutro de alimentación. Si sólo uno de estos fusibles fundiera, existen partes del equipo que pudieran permanecer a tensión de red.

Para retirar las tapas

Desconectar de red antes de retirar las tapas para evitar el riesgo que supone tener accesibles aquellas partes del equipo expuestas a alta tensión. Aquellas operaciones que requieran tener alimentación con las tapas abiertas para mantenimiento o ajuste deben de ser realizadas por personal cualificado, que esté al tanto de los riesgos implicados.

WARNING - Peligro de incendio

Asegúrese de utilizar sólo fusibles del tipo y valores especificados como recuesto.

Si se utiliza una clavija con fusible incorporado, asegúrese de que los valores del fusible corresponden a los requeridos por el equipo. Ver sección de especificaciones del capítulo 1 para comprobar los requisitos de alimentación.

WARNING - Instrumento pesado

Los MTS de las series 6200 o 6200A, si llevan instalado el mod. 6210, exceden de los 18 Kg. (40lb), lo que debe tenerse en cuenta si va a ser transportado manualmente por una sola persona. Para evitar el riesgo de lesiones, antes de mover el equipo deberá evaluar la carga, el entorno de trabajo y la propia capacidad, de acuerdo con la Directiva Europea 90/269/EEC y el Reglamento Nacional Asociado.

WARNING - Otros peligros

Alguno de los componentes utilizados en este equipo pudieran incluir resinas u otro tipo de materiales que al arder produjeran sustancias tóxicas, Por tanto, tome las debidas precauciones en la manipulación de esas piezas.

Berilio

Berilio (óxido de berilio) Este material es utilizado en la fabricación de alguno de los componentes de este equipo.

Si se manipulase incorrectamente podria causar daños a la salud - En la sección de mantenimiento y reparación encontrará normas de manejo de seguridad.

Litio

En este equipo se utiliza una batería de **litio** (o contenida dentro de un CI).

Dada que el **litio** es una substancia tóxica las baterías de este material no deben ser aplastadas, quemadas o arrojadas junto a basuras ordinarias.

No trate de recargar este tipo de baterías. No las cortocircuite o fuerce su descarga ya que puede dar lugar a que la esta emita gases, se recaliente o explote.

El siguiente aviso solo es de aplicación para instrumentos de la serie 6200 (con pantalla de tubo de rayos catódicos).

WARNING - TUBO DE RAYOS CATÓDICOS

Tubo de rayos catódicos. Al manipular un tubo, se recomienda hacerlo con cuidado para evitar su implosión y el posible desprendimiento de fragmentos de vidrio. La manipulación será realizada por personal cualificado, haciendo uso de mascarillas y guantes de seguridad. Los tubos defectuosos serán llevados de forma segura a una compañía de residuos autorizada.

WARNING - Tener en cuenta con el equipo inclinado

Si utiliza el equipo en posición inclinada, se recomienda, por razones de estabilidad, no apilar otros equipos encima de él.

Chapter 1
GENERAL INFORMATION

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PURPOSE AND FEATURES OF EQUIPMENT

Introduction

The 6200A Series RF and Microwave Test Sets are portable microwave measurement instruments, which integrate a synthesized sweep generator, a four input scalar analyzer, frequency counter and a power meter into a single compact case. Four versions are available: the 6201A covers 10 MHz to 8 GHz, the 6200A covers 10 MHz to 20 GHz, the 6203A covers 10 MHz to 26.5 GHz and the 6204A has coverage to 46 GHz. The 6202A covers 10 MHz to 2 GHz, and is especially suitable for users working exclusively in the RF band. Whereas the other instruments are called Microwave Test Sets, the 6202A is an RF Test Set. Throughout this and other manuals, however, the series of instruments will be referred to collectively as Microwave Test Sets (MTS).

A 70 dB step attenuator option is available for allversions except the 6204A, which provides synthesizer outputs over a wide amplitude range. The 6210 Reflection Analyzer adapter can be fitted to the MTS, which enables the instrument to display the complex reflection coefficient at the input of a device, and also the time domain response.

The small size, integrated functions and ease of use of the MTS make the system ideal for development and production testing, installation and commissioning and field service applications. Integrating many functions into one unit not only provides convenience of operation, it also enables a number of specialized measurements to be made with ease. Typical applications for the MTS are:

- Measurement of insertion loss and return loss of passive components.
- Gain, gain compression and return loss of active components.
- Power and frequency measurements.
- Measurements on mixers and VCOs.
- Location of faults in waveguide and coaxial transmission lines is possible using the Fault Location facility. This utilises advanced processing techniques to improve distance and magnitude accuracy and reduce measurement uncertainty.

Main Features

The MTS uses a fully synthesized frequency source. The swept signal it provides combines the speed and convenience of an analogue sweep generator with the precision of a synthesized sweep. High frequency stability and a resolution of 1 Hz ensures that even narrow filters can be measured with accuracy and confidence.

Power level is settable over a 40 dB range with a maximum guaranteed levelled power of +7 dBm. With the step attenuator option, amplitudes down to -90 dBm may be set for the characterization of amplifiers and other active devices.

Self calibration of the synthesizer's power and frequency is possible using the integral power meter and frequency counter of the MTS. Two user calibration stores can be used to perform power calibrations over a limited frequency range.

The four input scalar analyzer has typically 85 dB dynamic range and a high resolution colour display. As well as the conventional 10x10 graticule two separate 10x10 graticules can be selected. Two display channels, each capable of displaying up to two swept measurements are provided. The channels may be coupled together for the simultaneous update of up to four traces, or they can be uncoupled so that each channel can display a different frequency range, allowing simultaneous display of pass-band and stop-band characteristics, for example.

The power meter has a high dynamic range (-70 dBm to +35 dBm) and wide frequency coverage (30 kHz to 40 GHz). One input of the scalar analyzer can be configured to be a power sensor input, and the measured power level is displayed as a digital readout when the readout mode is selected. A wide range of power sensors is available. Power sensors can be calibrated using the 50 MHz internal calibrator output provided on the front panel.

The frequency counter measures frequency from 10 MHz to 20 GHz (6200A and 6201A) or 10 MHz to 26.5 GHz (6203A and 6204A). A digital readout of the frequency can be displayed when the readout mode is selected. In the swept mode, the vertical axis can be set to record the frequency of a device under test as the voltage stimulus provided by the programmable voltage/current output is swept, a typical example being automatic VCO characterization.

Operator Interface

The MTS firmware controls the functions of the synthesized source, scalar analyzer, frequency counter and power meter. Operator interaction with the system is performed a colour liquid crystal display (LCD) and the front panel controls. Menus, instructions, error messages and help text are displayed on the LCD, and menu selection is accomplished via a set of eight soft keys adjacent to the display.

The measurement to be performed is defined using a simple menu system. Non-volatile storage is provided for ten measurement setups and four results traces for future use. Stores are also provided for calibration and linearity factor data for up to ten power sensors.

GPIB commands are provided enabling full control of the system via the GPIB interface. This interface also enables the MTS to control an HPGL plotter and an additional MTS synthesized source. The GPIB complies with IEEE 488.2 and follows the SCPI convention (Standard Commands for Programmable Instrumentation).

A Macro facility allows a sequence of key presses and control codes to be stored so that complex measurement sequences can be stored.

Results Output

Measurement results, either current or stored, may be output to any HPGL GPIB plotter, or to a suitable printer via the Centronics parallel interface. The operator has extensive control of hard copy formatting, with facilities for generating titles. The printer can also be used to obtain hard copy output of tabular data, such as current or stored instrument settings, and information relating to the displayed measurement.

System Connections

Because the MTS incorporates several instruments in one case, there are no interconnections to make, other than the connections to the device or system under test. This provides more reliable and repeatable results, and saves time in setting up and re-deploying equipment.

Similar advantages are obtained when a Fault Location Test Head or Transmission Line Test Head is used for fault location measurements; this integrates most of the necessary microwave components (such as detectors, dividers) into a small housing. The Test Head is supplied with a length of cable for connection to the MTS scalar inputs, and an optional length of ruggedised cable connects the Test Head to the MTS RF output. This allows the Test Head to gain access to difficult to reach test points.

Memory Card System

Memory cards containing battery-backed non-volatile RAM are available which can be used for additional storage of measurement setups and results data. If required, this information can then be transferred to other instruments, ensuring repeatability and time saving in setting up a number of identical test stations. The MTS enables the user to configure blank cards to set the number of stores of each type within the available memory capacity of the card.

6210 Reflection Analyzer

If the optional 6210 Reflection Analyzer is fitted to a 6200A series MTS, the system has the additional capability of making measurements of the complex reflection coefficient (i.e. magnitude and phase) at the input of a test device; this is the S_{11} S-parameter. The results can be presented in several formats, enabling, for example, measurements of magnitude, phase, VSWR and impedance. The frequency range over which the 6210 operates is from 250 MHz to 26.5 GHz, the upper limit depending on that of the MTS. Note that although the 6204A MTS operates up to 46 GHz, the upper limit of the 6210 is still 26.5 GHz.

The system can also transform frequency domain measurements into the time domain, enabling measurement of the performance of a device as a function of time. Both band pass and low pass transforms are available, and the MTS can display the response of the system under test to a simulated impulse or step function.

In addition, the 6210's gating facility allows the selective removal of time domain responses (due to connectors, for example), and the effect on the frequency response can be seen on returning to the frequency domain. See Appendix D for an overview of time domain measurements.

SPECIAL TERMS USED IN THIS MANUAL

Sweep is a series of consecutive measurements taken over a sequence of source stimulus values corresponding to each measurement point. The number of points per sweep can be set by the user.

Input. The instrument has four scalar detector inputs A, B, C and D; the D input can also be defined as a power meter sensor input. A counter input is also available for measuring frequency.

Display Channel (or Channel) is a signal path associated with the display, and should not be confused with the term 'Input', defined above. The instrument is capable of displaying one or two channels simultaneously. Each channel can be defined to be either a swept channel (e.g. scalar or fault location) which is capable of displaying either one or two measurement traces, or as a readout channel which can display either one or two digital readouts derived from the power meter or counter. Thus a total of four traces/readouts can be displayed simultaneously.

Domain. For swept measurements, the domain is the variable plotted on the X (horizontal) axis of the channel graticule (e.g. frequency, power, distance). A swept channel is capable of displaying one or two traces of the same domain, i.e. both traces share the same x-axis annotation.

Response. For swept measurements, response is the measurement (e.g. power, voltage, frequency) that is displayed on the Y (vertical) axis of the graticule.

Measurement point is a single piece of data representing a measurement at a single source stimulus value.

Power Sensor. Power sensors are connected to the instrument's power meter via Input D of the MTS, and provide a signal representing the RF power incident upon them. The power measurement is displayed as a digital reading on a readout channel.

Detector. A detector provides a DC voltage representing the RF power incident upon it, but has a wide dynamic range and fast response time, making it suitable for swept measurements.

The following terms are associated with fault location measurements:

Distance resolution is the minimum separation at which two peaks can be distinguished, and is inversely proportional to the measurement bandwidth.

Amplitude error occurs when a time domain peak falls between two adjacent points, leading to an underestimate of the amplitude of the peak. Amplitude error is a function of point spacing: the more measurement points there are the smaller the error.

Point spacing is the time interval between adjacent points on a swept display; the higher the number of measurement (domain) points, the smaller the point spacing. Point spacing is important for both amplitude accuracy and the accurate location of discontinuities in fault location measurements.

ASSOCIATED PUBLICATIONS

Two other manuals are supplied with the MTS, which provide the following information:

- The **GPIB Operating Manual** covers remote operations of the MTS. A full description is given of the GPIB command set and the conventions used in the implementation of the commands. The manual assumes familiarity with local operation of the instrument.
- The **Getting Started Manual** shows how the instrument is used by providing examples of some typical measurement situations.

Synthesized Sweep Generator

FREQUENCY

Range

6200A	10 MHz to 20 GHz.
6201A	10 MHz to 8 GHz
6202A	10 MHz to 2 GHz
6203A	10 MHz to 26.5 GHz.
6204A	10 MHz to 46 GHz

Resolution

10 MHz to 26.5 GHz	1 Hz
26.5 GHz to 46 GHz	2 Hz

CW Accuracy

10 MHz to 26.5 GHz	<±50 Hz ±Frequency standard accuracy
26.5 GHz to 46 GHz	<±100 Hz ±Frequency standard accuracy

Typical Swept Accuracy

Step time:	**250 µs**	**1 ms**	**10 ms**
10 MHz to 2 GHz	<5 kHz	<500 Hz	<50 Hz
>2 GHz	<100 kHz	<1.5 kHz	<50 Hz

POWER

Levelled Power Range

6200A/6201A/6202A/6203A standard	**Guaranteed power**	**Max. power typical**
10 MHz to 2 GHz	-10 dBm to +7 dBm	+11 dBm
2 GHz to 8 GHz	-10 dBm to +6 dBm	+8 dBm
8 GHz to 18 GHz	-10 dBm to +5 dBm	+10 dBm
18 GHz to 20 GHz	-10 dBm to +5 dBm	+8 dBm
20 GHz to 26.5 GHz	-10 dBm to +4 dBm	+8 dBm

6204A

10 MHz to 2 GHz	-10 dBm to +6 dBm	+10 dBm
2 GHz to 8 GHz	-10 dBm to +5 dBm	+8 dBm
8 GHz to 18 GHz	-10 dBm to +5 dBm	+8 dBm
18 GHz to 20 GHz	-10 dBm to +5 dBm	+6 dBm
20 GHz to 26.5 GHz	-10 dBm to +3 dBm	+6 dBm
26.5 GHz to 40 GHz	-10 dBm to 0 dBm	+2 dBm
40 GHz to 46 GHz	-10 dBm to -3 dBm typical	-1 dBm

6200A/6201A/6202A/6203A + Option 001 (step attenuator)	**Guaranteed power**	**Max. power typical**
10 MHz to 2 GHz	-80 dBm to +5 dBm	+9 dBm
2 GHz to 8 GHz	-80 dBm to +4 dBm	+6 dBm
8 GHz to 18 GHz	-80 dBm to +3 dBm	+7 dBm
18 GHz to 20 GHz	-80 dBm to +2 dBm	+5 dBm
20 GHz to 26.5 GHz	-80 dBm to +1 dBm	+4 dBm

For Option 002 (field replaceable RF connector, available for 6200A, 6201A, 6202A and 6203A) guaranteed levelled output is reduced by 0.5 dB.

Settable power range

Standard	-20 dBm to +20 dBm.
6200A/6201A/6202A/6203A + Option 001	-90 dBm to +20 dBm.

Resolution 0.01 dB

Power sweep range
(from maximum levelled power)

Standard

10 MHz to 26.5 GHz	>25 dB
26.5 GHz to 40 GHz	>10 dB
40 GHz to 46 GHz	>7 dB typical

6200A/6201A/6202A/6203A + Option 001 >80 dB

INTERNAL LEVELLING

6200A/6201A/6202A/6203A/6204A standard
(including Option 002 if fitted to
6200A/6201A/6202A/6203A)

Accuracy (including flatness at
0 dBm)

10 MHz to 26.5 GHz	<±1 dB, <±0.5 dB typical
26.5 GHz to 40 GHz	<±1.5 dB, <±0.7 dB typical
40 GHz to 46 GHz	<±3 dB typical

Linearity <±0.5 dB over guaranteed levelled power range

6200A/6201A/6202A/6203A + Option 001
(including Option 002 if fitted)

Accuracy (including flatness at
0 dBm)

10 MHz to 8 GHz	<±1 dB ±0.3 dB ±2% of attenuator setting in dB
8 GHz to 26.5 GHz	<±1 dB (±1 dB or ±4% of attenuator setting in dB, whichever is greater).

EXTERNAL LEVELLING

Via rear panel BNC input socket. Accepts signals from a detector (positive or negative) or from the analogue output of a power meter (0 to ±1 V). Accuracy depends on levelling technique.

POWER STABILITY WITH TEMPERATURE

6200A/6201A/6202A

Typical values following power calibration at operating temperature. Self-calibration with a power sensor removes temperature effects.

0 °C to 20°C	< 0.02 dB/°C.
20 °C to 40°C	< 0.04 dB/°C.
40 °C to 50°C	< 0.08 dB/°C.

6203A

0 °C to 20°C	< 0.1 dB/°C
20 °C to 30°C	< 0.08 dB/°C
30 °C to 50°C	< 0.06 dB/°C

6204A

	10 MHz to 2 GHz	2 GHz to 40 GHz
0 °C to 20°C	< 0.12 dB/°C	< 0.05 dB/°C
20 °C to 30°C	< 0.15 dB/°C	< 0.05 dB/°C
30 °C to 50°C	< 0.08 dB/°C	< 0.06 dB/°C

SIGNAL PURITY

Harmonics

10 MHz to 2 GHz	< -27 dBc, -35 dBc typical.
2 GHz to 8 GHz	< -35 dBc, -40 dBc typical.
8 GHz to 26.5 GHz	< -40 dBc, -50 dBc typical.
26.5 GHz to 40 GHz	<-20 dBc typical

Sub-harmonics

2 GHz to 26.5 GHz	None
26.5 GHz to 40 GHz	<-40 dBc typical

Spurious signals (typical)

	25 kHz to 150 kHz	150 kHz to 1 MHz	>1 MHz
10 MHz to 2 GHz	<-50 dBc	<-60 dBc	<-60 dBc
2 GHz to 8 GHz	<-50 dBc	<-50 dBc	<-60 dBc
8 GHz to 26.5 GHz	<-50 dBc	<-60 dBc	<-60 dBc
26.5 GHz to 40 GHz	<-40 dBc	<-50 dBc	<-50 dBc

There are no sub-harmonics for frequencies above 2 GHz.

Phase noise

Typical values measured in 1 Hz bandwidth at 20 kHz offset from the carrier in CW mode.

10 MHz to 2 GHz	< -90 dBc/Hz
2 GHz to 8 GHz	< -78 dBc/Hz
8 GHz to 12 GHz	< -74 dBc/Hz
12 GHz to 20 GHz	< -70 dBc/Hz
20 GHz to 26.5 GHz	< -67 dBc/Hz
26.5 GHz to 40 GHz	<-57 dBc/Hz

Residual FM

In 100 kHz bandwidth in CW mode

10 MHz to 2 GHz	<1 kHz peak
2 GHz to 26.5 GHz	<(500F) Hz peak where F is the frequency in GHz.
26.5 GHz to 46 GHz	<(1000F) Hz peak where F is the frequency in GHz.

OUTPUT CONNECTOR

Type

6200A/6201A/6202A	Precision N (female), 50 Ω.
6203A	MPC (Marconi Precision Connector) 3.5 mm (female), 50 Ω.
6204A	Precision 2.92 mm (female), 50 Ω.
Option 002	Field replaceable, 50 Ω precision 3.5 mm (female) and N-type (female).

Reverse input power

100 mW maximum.

Source match (internally levelled)

6200A/6201A/6202A/6203A

	VSWR (minimum)	Return Loss (dB) Typical	Minimum
10 MHz to 50 MHz	< 1.45 : 1	>17	>15
50 MHz to 2 GHz	< 1.11 : 1	>33	>26
2 GHz to 8 GHz	< 1.2 : 1	>30	>21
8 GHz to 12 GHz	< 1.35 : 1	>25	>16.5
12 GHz to 26.5 GHz	< 1.45 : 1	>20	>15
6204A			
10 MHz to 40 GHz	< 1.93 : 1	>12	>10
40 GHz to 46 GHz	< 1.93 : 1	>10	

With option 001 minimum return loss specification degrades by up to 5 dB.

With option 002 minimum return loss specification degrades by up to 3 dB.

VOLTS/GHz

Voltage proportional to frequency available from rear panel BNC Voltage/Current output.

Range

1 V or 0.5 V/GHz selectable (20 V maximum in 1 V/GHz mode).

Linearity

±15 mV.

VOLTAGE RAMP OUTPUT

0 to +10 V ramp output proportional to the start and stop values of a frequency or power sweep, available from rear panel BNC Voltage/Current output.

Programmable Voltage/Current Source

VOLTAGE OUTPUT

Range	-15 V to +15 V
Resolution	1 mV
Accuracy	±15 mV

Total power supplied not to exceed 2.5 W.

CURRENT OUTPUT

Range	-150 mA to +150 mA
Resolution	10 µA
Accuracy	±300 µA
Stability with temperature	10 µA/°C

Total power supplied not to exceed 1.25 W.

OUTPUT CONNECTOR

Rear panel BNC.

Scalar Analyzer

NUMBER OF INPUTS

Four (A, B, C and D)

DETECTION MODES

AC and DC.

DYNAMIC RANGE

AC detection	80 dB (-60 to +20 dBm), 85 dB typical (-65 to +20 dBm)
DC detection	70 dB (-50 to +20 dBm)

NUMBER OF MEASUREMENT POINTS

User selectable from 2 to 1601.

NUMBER OF CHANNELS

Two. Two measurements may be made per channel allowing a total of four simultaneous measurements.

SWEEP TIME

Settable range	40 ms to 500 s, automatically selected or manually entered.
Measurement times	
401 points	<200 ms.
1601 points	<800 ms.

DIRECT VOLTAGE INPUT RANGE

Input A, B and C	0 to -4.5 V or 0 to +4.5 V, depending on accessory cable used
Input D	0 to -9 V or 0 to +9 V, depending on accessory cable used

NOISE REDUCTION

Averaging	1 to 1000 (applied per measurement).
Smoothing	Aperture settable from 0.01 to 20% of span, resolution 0.01%

CALIBRATION

Path calibration (normalization)types	Through, short/open, short.

INSTRUMENTATION ACCURACY

±0.05%

SYSTEM ACCURACY

Refer to individual specifications for detectors and Return Loss Bridges.

Fault Location

DISTANCE

Units	Metres or feet.
Accuracy	0.1% of range or 3 mm, whichever is the larger (for a single fault up to 1 km range).
Full scale	Up to 25 km depending on cable or waveguide loss.
Minimum resolution	For two equal amplitude discontinuities using maximum sweep width.
6200A	$1.82 \times V_r$ cm.
6201A	$4.54 \times V_r$ cm
6202A	$18.2 \times V_r$ cm
6203A	$1.37 \times V_r$ cm
6204A	$0.91 \times V_r$ cm
	where V_r is relative volicity.

DYNAMIC RANGE

	10 MHz to 26.5 GHz	26.5 to 40 GHz
AC detection	80 dB	>40 dB typical
DC detection	70 dB	>40 dB typical

MEASUREMENT TIME
(401 points)

Normal mode	< 250 ms
Enhanced mode	< 500 ms

NUMBER OF MEASUREMENT POINTS

User selectable from 51 to 512.

Power Meter

Input D may be defined either as a power meter sensor input or as a scalar detector input.

FREQUENCY RANGE — 30 kHz to 40 GHz, dependent upon sensor used.

POWER RANGE — -70 dBm (100 pW) to +35 dBm (3 W), dependent upon sensor used.

INSTRUMENTATION ACCURACY — ±0.05%

CORRECTION

Calibration Factor	
Range	0.01 to 200%
Resolution	0.01%
Linearity Factor	
Range	0.1 to 15
Resolution	0.1

POWER REFERENCE — Used for Power Sensor correction.

Output Connector	N (female) 50 Ω. Adapters are supplied with 75 Ω and MPC (Marconi Precision Connector) 3.5 mm Power Sensors.
Frequency	50 MHz ±0.01 MHz.
Level	1 mW.
Uncertainty	±0.7% traceable to National Standards.
Accuracy	±1.2% worst case for one year.

AUTO-ZERO

Set	Removes DC offset from signal input.
6910 Series	±200 nW.
6920 Series	±100 pW.
6930 Series	±6 µW.
Drift over 1 hr at constant temperature	
6910 Series	±10 nW.
6920 Series	±100 pW.
6930 Series	±300 nW.

Noise	
6910 Series	±100 nW.
6920 Series	±100 pW.
6930 Series	±3 µW.
RESPONSE TIME	< 100 ms.
AVERAGING	1 to 1000 selected automatically or manually entered. Also selectable by resolution: 0.01, 0.1 or 1 dB
RESOLUTION	2 to 4 digits, user selectable
CHART RECORDER	Rear panel voltage/current BNC output gives a voltage proportional to measured power.
Sensitivity	0 to 5 V. 0 V level dependent upon type of detector or sensor used.
Log mode	1 V per decade.
Linear mode	Scaling dependent on detector or sensor.

Frequency Counter

FREQUENCY RANGE

6202A	10 MHz to 2 GHz
6200A/6201A/	10 MHz to 20 GHz.
6203A/6204A	10 MHz to 26.5 GHz.

RESOLUTION

Readout mode: Selectable from 1 Hz to 100 MHz in decade steps.

Swept mode: 6 digits

ACCURACY

Readout mode: <±25 Hz ± frequency standard error.

Swept mode: (6 significant figures or ±100 Hz whichever is greater) ± frequency standard error.

SENSITIVITY
(typical)

	6200A/6201A/6202A/6203A	6204A
25 MHz to 10 GHz	< -20 dBm	<-19 dBm
10 GHz to 20 GHz	< -15 dBm	<-14 dBm
20 GHz to 26.5 GHz	< -10 dBm	<-8 dBm

MAXIMUM INPUT LEVEL

+5 dBm typical.

DAMAGE LEVEL

+27 dBm peak.

INPUT CONNECTOR

Type

6200A/6201A/6202A	Precision N Type (female).
6203A/6204A	MPC (Marconi Precision Connector) 3.5 mm (female).
Option 002	Field replaceable, 50 Ω precision 3.5 mm (female) and N-type (female).

Input impedance: 50 Ω nominal.

FM TOLERANCE

Readout mode: 20 MHz peak to peak at 45 Hz to 10 MHz rate.

Swept mode: 1.5 MHz peak to peak at 75 Hz to 10 MHz rate.

AM TOLERANCE

Up to 40% modulation depth for signals within the range of sensitivity and maximum input level.

ACQUISITION TIME

Readout mode: Typically 2s for frequencies greater than 300 MHz, at 1 Hz resolution.

Swept mode: Typically 150 ms per point.

SELECTIVITY

Typically 25 dB.

Display

TYPE

Colour active matrix TFT liquid crystal display 16.5 cm (6.5 inch) visible diagonal. External colour monitor (VGA) output available on rear panel.

NUMBER OF CHANNELS

Two. A channel may be configured either as a swept channel for displaying traces or a readout channel for displaying readouts of values such as power and frequency.

NUMBER OF TRACES/READOUTS

Four. Maximum of two per channel.

TITLES

Screen title plus individual measurement titles. Individual title coded to each trace/readout.

Swept channel characteristics

The horizontal and vertical axes can be configured to display a variety of different measurements. The horizontal axes, referred to as 'Domain', may be defined to display the stimulus such as frequency, power, voltage, current and distance. The vertical axis, referred to as 'response', may display frequency, power and voltage.

DOMAIN
(Horizontal axis)

Frequency modes	CW, start/stop, centre/span, alternate sweep.
Frequency resolution	Settable to 1 Hz, displayed as 6 digits.
Frequency offset	Frequency offset between source and display can be entered to characterize frequency changing devices such as mixers.
Frequency scaling	Multiplication factor between source and display can be entered to characterize frequency multipliers and dividers.
Power sweep range	Range depends on Option - refer to Synthesized Sweep Generator section.
Power offset	Power offset between source and display can be entered for use when measuring amplifiers and attenuators.

RESPONSE
(Vertical axis)

Units	dBm, dB, pW to kW, nV to V, VSWR, Hz to GHz.
Scaling	Manual auto-scale (single shot), continuous auto-scale (every sweep) or user selectable.
Reference level position	Reference level may be set to any graticule line.
Reference level value	-199.99 to +199.99 all units except VSWR. 1 to 100 VSWR.

MEASUREMENT MANIPULATION

Scalar detector and counter inputs	Display live measurement. Display trace memory. Display live measurement relative to trace memory. Measurement hold may be applied for each trace.
Scalar detector inputs only	Any input or ratio of inputs may be assigned to any one or more than one of the traces. A trace may display absolute power, power relative to a path calibration or power minus a trace memory.
Complex limit lines	Four stores of 12 segments each. Each segment defines an upper and a lower limit line or point. Any store can be applied to any trace.
Input offsets	An offset in the range -99.99 to +99.99 dB in 0.01 dB steps may be applied per detector input.

MARKERS

Eight per channel plus a separate delta marker.

Marker functions

Marker, delta marker, minimum, maximum, search left, search right, N dB bandwidth (with centre frequency). Peak to peak response value and optional test against limit. dB/Octave and dB/Decade. Tracking for Max/Min, Peak to Peak and Bandwidth functions. Bandwidth function has ability to show centre frequency/delta frequency ratio.

MARKER RESOLUTION

Domain (Horizontal)

Frequency	Six digits with over-ride to give 1 Hz resolution.
Power	0.01 dB.
Voltage	1 mV.
Current	10 µA.

Response (Vertical)

Power	0.01 dB.
Frequency	Six digits.
Voltage	1 nV.

Readout channel characteristics

RESOLUTION

Power	2 to 4 digits, user selectable.
Frequency	1 Hz. to 100 MHz, user selectable.
Voltage	Four digits.

UNITS

Power	dBm, dB, pW to kW.
Frequency	Hz to GHz.
Voltage	nV, uV, mV, V, kV.

MEASUREMENT MANIPULATION

Marker readout	Spot readings may be made at the domain value specified by the active marker.
Limit checking	Upper and lower test limits may be entered.
Relative measurement	To display the measured offset from a previously entered measured reading.
Max/min hold	To display maximum and minimum values over a period of time for drift measurements.
Duty cycle	To display peak power given by average power measured/duty cycle. Range: 0.001 to 100%
Peaking meter display	Analogue display to assist when adjusting power levels.
Input offsets	An offset in the range -99.99 to +99.99 dB in 0.01 dB steps may be applied per detector or sensor input.

Auxiliary Inputs and Outputs

GPIB INTERFACE

GPIB is IEEE 488.1 and 488.2 compatible. The interface has three applications:

- Instrument control with full talk and listen capability.
- Control of a plotter using HPGL. Plotter output is buffered to permit measurements to proceed whilst plotting.
- Control of a second MTS for mixer measurements. The instruments may be set to sweep with a fixed frequency offset between them.

MEMORY CARD INTERFACE

For external storage of data.

PARALLEL PRINTER OUTPUT

Compatible with Epson FX, Hewlett Packard DeskJet/LaserJet or Canon BJ series printers. A mechanism is provided to select which type of printer is connected. Output is buffered to allow further measurements whilst printing.

FREQUENCY STANDARD IN/OUT BNC

1 or 10 MHz input or 10 MHz output (nominally 2 V pk-pk into 50 Ω) selectable from front panel.

EXTERNAL LEVELLING INPUT BNC

For connection of remote detector or power meter for source levelling.

VOLTAGE/CURRENT OUTPUT BNC

User definable to be:

Volts/GHz	Voltage proportional to frequency output from source.
Fixed	Fixed voltage or current output for bias measurements.
Swept V/I	Swept voltage or current for voltage/current domain measurements.
Chart recorder	Voltage proportional to power level of scalar detector or power meter sensor input.
Ramp output	0 to +10 V ramp output proportional to the start and stop values of a frequency or power sweep.

EXTERNAL MONITOR

Output to a VGA 640 x 480 standard colour monitor. Rear panel 15 way "high density" D-type female connector.

FREQUENCY STANDARD

For synthesized sweep generator and frequency counter.

Internal

30 MHz VCXO.

Temperature stability

Better than ±0.5 ppm/°C.

Ageing

Better than ±1 in 10^6 per year.

External

1 or 10 MHz standard rear panel BNC input socket.

MEMORIES

Standard

Trace memories

4

Settings stores

10

Power sensor cal stores

Stores for 10 sets of power sensor calibration and linearity factor data.

Memory card

Extra stores available on memory card.

REAL TIME CLOCK

Date and time.

Used to date-stamp hard copies and to determine instrument operating hours.

ELECTRO-MAGNETIC COMPATIBILITY

Conforms with the protection requirements of EEC Council Directive 89/336/EEC.

Complies with the limits specified in the following standards:

EN55011 Class B	CISPR 11
EN50082-1	IEC 801-2,3,4
EN60555-2	IEC 555-2

SAFETY

Complies with IEC 348.

RATED RANGE OF USE (over which full specification is met)

Temperature

0 to 50°C.

Humidity

93% RH at 40°C

CONDITIONS OF STORAGE AND TRANSPORT

Temperature

-40 to +70°C.

Humidity

93% RH at 40°C.

POWER REQUIREMENTS

Switchable voltage ranges	
115 V set	90 to 132 V
230 V set	188 to 265 V
AC Supply	45 to 440 Hz. 500 VA maximum.

DIMENSIONS AND WEIGHT

Height	197 mm (7.75 in)
Width	389 mm (15.3 in)
Depth	546 mm (21.5 in)
Weight	
6200A	16 kg (35 lb)
6201A	15 kg (33 lb)
6202A	14.5 kg (32 lb)
6203A	16.25 kg (36 lb)
6204A	17 kg (37.9 lb)

NOTES:

Guaranteed Power Range, Power Accuracy and VSWR are calibrated for the temperature range 0 to 50°C and are subject to the availability of National Standards.

Typical performance figures are non-warranted.

VERSIONS AND ACCESSORIES - 6200A SERIES MTS

Ordering numbers	Versions
6200A	10 MHz to 20 GHz Microwave Test Set
6201A	10 MHz to 8 GHz Microwave Test Set
6202A	10 MHz to 2 GHz RF Test Set
6203A	10 MHz to 26.5 GHz Microwave Test Set
6204A	10 MHz to 46 GHz Microwave Test Set

Options
(Not available for 6204A)

Option 001	70 dB step attenuator
Option 002	Field replaceable RF output connector (3.5 mm and N-type)

SUPPLIED ACCESSORIES

43123-076Y	AC supply lead
06950-081W	2 m power sensor cable
46882-106P	Operating manual
06950-069	Input socket cap
46882-256E	GPIB Operating Manual
46882-257U	Getting Started Manual

OPTIONAL ACCESSORIES

6230 Series Scalar Detectors

56230-501T	10 MHz to 20 GHz, N type (m)
56233-501K	10 MHz to 26.5 GHz, MPC (Marconi Precision Connector) 3.5 mm (m)
56234-501F	10 MHz to 40 GHz, 2.92 mm (m)

Power Meter Sensors

6910 Series (-30 dBm to +20 dBm)

56910-900L	10 MHz to 20 GHz, N type (m)
56911-900X	10 MHz to 20 GHz, APC 7.
56912-900U	30 kHz to 4.2 GHz, N type (m)
56913-900D	10 MHz to 26.5 GHz, MPC (Marconi Precision Connector) 3.5 mm (m).
56914-001R	10 MHz to 40 GHz, 2.92 mm (m)
56914-002B	10 MHz to 40 GHz, 2.92 mm (m) plus waveguide 22 transformer
56919-900Y	30 kHz to 3 GHz, N type 75 Ω. (m)

6920 Series (-70 dBm to -20 dBm)

56920-900J	10 MHz to 20 GHz, N type (m)
56923-900T	10 MHz to 26.5 GHz, MPC (Marconi Precision Connector) 3.5 mm (m).
56924-001B	10 MHz to 40 GHz, 2.92 mm (m)
56924-002K	10 MHz to 40 GHz, 2.92 mm (m) plus waveguide 22 transformer

6930 Series (-15 dBm to +35 dBm)

56930-900F	10 MHz to 18 GHz, N type (m)
56932-900N	30 kHz to 4.2 GHz, N type (m)
56934-001K	10 MHz to 40 GHz, 2.92 mm (m)
56934-002A	10 MHz to 40 GHz, 2.92 mm (m) plus waveguide 22 transformer

Transmission Line Test Heads

56581-001T	20 GHz Transmission Line Test Head, 6581
56583-001S	26.5 GHz Transmission Line Test Head, 6583 (usable to 40 GHz for fault location).

Fault Location Test Heads

56581-002P	20 GHz Fault Location Test Head, 6581E
56583-002W	26.5 GHz Fault Location Test Head, 6583E (usable to 40 GHz for fault location).

Pulse Modulator

56145-001A	70 MHz to 20 GHz Pulse Modulator, 6145
54441-019A	AC power supply

Sensor/Detector Cables

06950-086M	5 m Power sensor cable
06950-087C	15 m Power sensor cable
06950-088R	50 m Power sensor cable
03964-325P	5 m Detector extension cable
54311-111E	15 m Detector extension cable
54311-113Y	25 m Detector extension cable
54311-112U	Negative Voltage measurement cable
54311-170B	Positive Voltage measurement cable
54311-118G	1.5 m extension cable for Transmission Line Test Head.
54311-120F	1.5 m extension cable for Fault Location Test Head.

Miscellaneous Electrical Cables

43129-189U	GPIB Cable
43126-012S	50 Ω BNC(m) to BNC(m), 1.5 m
46884-560M	Parallel printer interface cable

Microwave Cables

54311-109U	Ruggedized cable N(m) to N(m) 3 m (for Fault location)
54311-110H	Ruggedized Cable 3.5 mm (m) to 3.5 mm (m) 3 m (for Fault location)
54311-116J	Ruggedized cable N(m) to N(m), 1.5 m (for Fault Location)
54311-117F	Ruggedized cable 3.5 mm(m) for 3.5 mm (m), 1.5 m (for Fault Location)
54351-022X	Cable N(m) to N(m) 0.5 m
54351-025R	Cable 3.5 mm (m) to 3.5 mm (m) 0.5 m
54351-027K	Cable 2.92 mm (m) to 2.92 mm(m) 0.5 m

Return Loss Bridges (Autotesters)

59999-151W	10 MHz to 18 GHz 7 mm
59999-158R	10 MHz to 18 GHz N(f)
59999-159B	10 MHz to 18 GHz N(m)
59999-152D	10 MHz to 26.5 GHz WSMA (m)
59999-166H	10 MHz to 26.5 GHz WSMA (f)
59999-168V	10 MHz to 40 GHz 2.92 mm (m)
59999-169V	10 MHz to 40 GHz 2.92 mm (f)
59999-170E	5 MHz to 2 GHz N (f)

Power Splitters

54311-123S	Power splitter DC to 18 GHz Type N
54311-124W	Power splitter DC to 26.5 GHz 3.5 mm
54311-161T	Power splitter DC to 40 GHz 2.92 mm
54311-187S	Power divider DC to 18 GHz
54311-188W	Power divider DC to 26.5 GHz

Applications and Memory Cards

59000-181G	32K blank memory card
59000-182V	128K blank memory card
59000-186T	512K blank memory card
59000-264R	Transmission Line Database
59000-265B	Gain Compression Application
59000-280L	Guided Measurements Application
54211-009X	Memory card reader/writer unit
54441-016R	AC adapter - UK style for reader/writer
54441-017B	AC adapter - European style for reader/writer
54441-018K	AC adapter - USA style for reader /writer

Miscellaneous

54127-309Z	Rack mounting kit
54127-311A	Additional rack mounting kit when a 6210 is fitted.
54124-027S	Front stowage cover
54417-002R	Waveguide 22 to 2.92 mm transformer
54121-034F	Detector input socket cap
54112-160G	Hard flight case for 6200 and 6210
54112-161V	Hard flight case for 6200
54112-157G	Soft carrying case
46882-239T	6200A Series Maintenance Manual

ASSOCIATED EQUIPMENT

The following items of equipment are recommended for use with the MTS, since they are known to operate satisfactorily with the instrument.

HPGL GPIB Plotters
- HP 7440A
- HP 7470A
- HP 7475A

Epson FX Series Printers
- Epson FX-105
- Epson FX-800
- Epson FX-850
- Epson FX-1000

Hewlett Packard DeskJet/LaserJet Series Printers
- HP DeskJet 500
- HP DeskJet 500C
- HP DeskJet 550C
- HP LaserJet 4L
- HP LaserJet 4P

Canon BJ Series Printers
- Canon BJ10EX
- Canon BJ10SX
- Canon BJ330

VGA 640 x 480 standard colour monitors
- Mitsubishi FA3415 ETKL
- Taxan 770 Plus

The monitor cable must be specified for use with a VGA interface, and must have a 15-way D-type female connector, for connection to the EXT MONITOR input of the MTS.

PERFORMANCE DATA - 6210 REFLECTION ANALYZER

NUMBER OF TEST PORTS

One, for the measurement of S_{11}.

FREQUENCY RANGE

When used with:		
	6202A	250 MHz to 2 GHz
	6201A	250 MHz to 8 GHz
	6200A	250 MHz to 20 GHz
	6203A/6204A	250 MHz to 26.5 GHz

DYNAMIC RANGE (Noise Floor)
(Source set to +3 dBm)

250 MHz to 500 MHz	>50 dB, 60 dB typical
500 MHz to 18 GHz	>60 dB
18 GHz to 26.5 GHz	>50 dB, 60 dB typical

INSERTION LOSS FROM RF INPUT TO TEST PORT

Typically 5 + (8 x f/26.5) dB
where f is the set frequency in GHz.

NUMBER OF MEASUREMENT POINTS

1 to 800, user selectable.

SWEEP TIME

Auto	Sweep time is as fast as possible for the attributes selected.
Manual	Sweep time will never be less than the sweep time entered and may be greater depending on constraints imposed by the system hardware, number of points and measurement software processing overhead.
Fastest time (401 points)	300 ms
Settable range	40 ms to 500 s

NOISE REDUCTION

Averaging	1 to 1000 (applied instrument wide).
Smoothing	0.01% to 20% of span, resolution 0.01%.

CALIBRATION

Calibration types	1 port
Coax	Short, Open, Fixed Load Short, Open, Sliding Load
Waveguide	Short, Offset Short, Fixed Load Short, 2 x Offset Shorts Short, Offset Short, Sliding Load
	In addition, the ability to specify sex and connector type of the test port.

Number of cal points	Same as number of measurement points.
Calibration kits (optional)	
Economy	Type N and 3.5 mm
Full	Type N, 3.5 mm and 7 mm
Calibration stores	Four
	Additional storage is available via memory card (optional accessory).

REFLECTION ANALYZER SYSTEM PERFORMANCE

Dependent on calibration kit used. Specifications assume a 2 hour warm up period from power on, and an ambient temperature of 23°C ±3°C.

N type cal kit (economy)	
Directivity	
<2 GHz	>40 dB
2 GHz to 18 GHz	>30 dB
Source match	
<2 GHz	>30 dB
2 GHz to 18 GHz	>24 dB
Frequency response	Within ±0.25 dB
N type cal kit (full)	
Directivity	>40 dB
Source match	>30 dB
Frequency response	Within ±0.2 dB
7 mm type cal kit (full)	
Directivity	>50 dB
Source match	>40 dB
Frequency response	Within ±0.1 dB
3.5 mm type cal kit (economy)	
Directivity	
<2 GHz	>40 dB
2 GHz to 26.5 GHz	>25 dB
Source match	
<2 GHz	>30 dB
2 GHz to 26.5 GHz	>22 dB
Frequency response	Within ±0.4 dB

3.5 mm type cal kit (full)

Directivity	>40 dB
Source match	>30 dB
Frequency response	Within ±0.2 dB

REFLECTION ANALYZER CHANNEL FEATURES

DOMAINS

Frequency

Modes	CW, F1-F2, centre/span, frequency list sweep, harmonic frequency sweep, waveguide frequency sweep. Ability to blank frequency information.
Resolution	1 Hz settable. Six digits displayed on graticule

Power

Sweep range	25 dB 85 dB with MTS step attenuator option
Resolution	0.01 dB settable.
Offset	Ability to enter offset (per channel) between source and display.

Time	Time domain domain response for impedance discontinuity analysis.
Stimuli	Low-pass step Low-pass impulse Band-pass impulse
Resolution (26.5 GHz sweep)	
Reflection (in air transmission lines)	0.7 cm, low-pass. 1.4 cm, band-pass.
Point spacing	<0.01 cm
Windowing	Kaiser Bessel, user definable.
Gating	User definable start, stop and shape.
Fencing	User definable start, stop and shape.

Voltage/current		Ability to sweep MTS rear panel V/I output in the range -15 V to +15 V (±15 mV, 2.5 W max) or -150 mA to +150 mA (±300 µA, 1.25 W max
	Voltage resolution	1 mV
	Current resolution	10 µA
RESPONSE		
Format		
	Cartesian	Logarithmic magnitude, linear magnitude, phase, VSWR, real, imaginary, impedance.
	Polar	Logarithmic magnitude, linear magnitude, Smith, inverse Smith.
Scaling		
	Magnitude	
	Log format Lin format	0.01 dB/div to 20 dB/div in 1,2,5 sequence. 10^{-12} units/div to 10^{3} units/div.
	Phase	
	Cartesian Polar	0.1°/div to 180°/div 45°/div
Reference level position		Any graticule line.
Reference level value		-99.99 to +99.99 all units except VSWR. 1 to 100 VSWR.
MEASUREMENT MANIPULATION		
Display		Display live measurement. Display trace memory. Display user-defined expressions involving subtraction and division on a live measurement and a trace memory. Measurement hold applied per trace.
Complex limit lines		Four stores of 12 segments each. Each segment defines an upper and a lower limit line. Any store can be applied to any trace.
Markers		Eight per trace, any one of which can be enabled to become the active marker, plus a separate delta marker.

Marker domain resolution		
	Frequency	Six digits with over-ride to give 1 Hz resolution.
	Power	0.01 dB
	Voltage	1 mV
	Current	10 μA
Marker response resolution		
	Magnitude	0.01 dB, log format. Six digits, lin format.
	Phase	0.01°
Marker functions		Active marker, delta marker, minimum, maximum, search left, search right, N-dB bandwidth, peak-to-peak response.
Reference plane extension		User definable
	Electrical delay	±1 s maximum or ±300,000 km
	Phase offset	±360° maximum
Non-dispersive media		Ability to enter delay as either physical length (m) or electrical delay (s).
		Relative velocity (V_r) and relative permittivity (ε_r) may be entered.
Characteristic impedance		User definable; default 50 Ω.
Waveguide cutoff frequency		User definable.

TEST PORT CONNECTOR

Type	Ruggedised precision 3.5 mm male.
Maximum input power	0.5 W

POWER CONSUMPTION

50 W maximum (in addition to MTS consumption).

DIMENSIONS AND WEIGHT

Height	46 mm (1.8 in)
Width	325 mm (12.8 in)
Depth	450 mm (17.7 in)
Weight	6.5 kg (14.3 lb)

OPTIONS AND ACCESSORIES - 6210 REFLECTION ANALYZER

Options

Option 011	Bias Tee
Option 012	Retrofit version

Note...

The 6210 can be supplied as part of a system with one of the 6200A Series Microwave Test Sets (MTS) or as a retrofit version for fitting to an existing MTS. The MTS must be fitted with software issue 2.0 or higher; software upgrades are available if required.

SUPPLIED ACCESSORIES

43138-328X	Auxiliary signal channel cable
43138-283G	Auxiliary data cable
43138-284V	Auxiliary power cable
54311-180Y	RF interconnection cable, N type
54311-181N	RF interconnection cable, 3.5 mm

OPTIONAL ACCESSORIES

Cal Kit, Type N - economy version

54424-005X — Comprising:

2 x short circuit (male and female)
2 x open circuit (male and female)
2 x fixed load (male and female)
Ruggedised 3.5 mm to N(m) adapter
Ruggedised 3.5 mm to N(f) adapter

Fixed load return loss:

<2 GHz	40 dB
2 GHz to 18 GHz	30 dB

Optional Accessories:

54425-004E	Gauge kit (N-type), comprising: 2 x gauges, (m) and (f) Adapter and gauge blocks
54311-166R	N-type male/male matched adapter
54311-167B	N-type male/female matched adapter
54311-168K	N-type female/female matched adapter

Cal Kit, Type N - full version

54424-003T — Comprising:

As economy kit plus
2 x sliding load (male and female)

Optional Accessory:

54425-002D — Precision 30 cm airline (N-type)

Cal Kit, 3.5 mm - economy version

54424-009	Comprising:
	2 x short circuit (male and female)
	2 x open circuit (male and female)
	2 x fixed load (male and female)
	Female/female precision adapter
	Fixed load return loss:
	<2 GHz 40 dB
	2 GHz to 26.5 GHz 25 dB
	Optional Accessories:
54425-005U	Gauge kit (3.5 mm), comprising:
	2 x gauges (m) and (f)
	Adapter and gauge blocks
54152-001B	3.5 mm torque wrench
54311-164M	3.5 mm male/male matched adapter
54311-165C	3.5 mm male/female matched adapter

Cal Kit, 3.5 mm - full version

54424-007C	Comprising:
	As economy kit plus
	2 x sliding load (male and female)
	Optional Accessory:
54425-003H	Precision 15 cm airline (3.5 mm)

Cal Kit, 7 mm - full version

54424-001W	Comprising:
	Short circuit
	Open circuit
	Fixed load
	Sliding load
	Gauge and gauge block
	Ruggedised 3.5 mm (f) to 7 mm adapter
	Collet extractor
	Torque wrench
	Fixed load return loss:
	<2 GHz 50 dB
	2 GHz to 18 GHz 30 dB
	Optional Accessories:
54425-001A	Precision 30 cm airline (7 mm)
54425-163C	Ruggedised 3.5 mm (f) to 7 mmadapter
54425-009J	Fixed matched load (return loss as above

Test Port Cables

54311-155S	Ruggedised 3.5 mm (f) to 7 mm
54311-156W	Ruggedised 3.5 mm (f) to N-type (m)
54311-157D	Ruggedised 3.5 mm (f) to N-type (f)
54311-158T	Ruggedised 3.5 mm (f) to ruggedised 3.5 mm (m)
54311-159P	Ruggedised 3.5 mm (f) to standard 3.5 mm (f)

50 Ω Fixed Loads

54421-009D	7 mm Fixed Load
54421-010S	3.5 mm (f) Fixed Load
54421-011W	3.5 mm (m) Fixed Load
54421-012D	N-type (f) Fixed Load
54421-013T	N-type (m) Fixed Load

Miscellaneous

54112-157G	Soft carrying case
54124-028W	Front stowage cover for assembled MTS and 6210

Note...

Calibration kits and accessories carry a one year warranty excluding wear and tear and mis-use.

Chapter 2
INSTALLATION

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INITIAL VISUAL INSPECTION

Immediately after unpacking, thoroughly inspect the instrument for signs of physical damage that may have occurred during shipping. If any damage is found, or if the instrument fails the Goods-In Checks (see below), the instrument must be returned to the following address:

Marconi Instruments Ltd.
The Airport
LUTON
Bedfordshire LU2 9NS

Attach a label indicating the service required, type or model number, serial number and your return address. Use the container and packing materials that were used to ship the instrument.

AC POWER SUPPLY

The instrument requires an AC supply of 90 to 132 V or 188 to 265 V, 45 to 440 Hz, 500 VA. The required supply fuses (time lag) are 4 A for 90 to 132 V operation or 2.5 A for 188 to 265 V operation. Before switching on, ensure that the rear panel voltage selector switch (located above the AC supply connector) is in the

correct position and that the correct fuses are fitted. The switch is operated by inserting a screwdriver blade into the recessed slot and pushing the switch to one side (see Fig. 2-1).

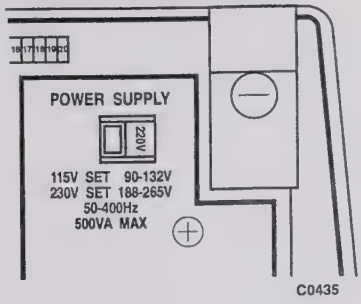

Fig. 2-1 Location of Supply Voltage Selector Switch

The AC supply cable is fitted at one end with a female plug which mates with the AC connector at the rear of the instrument. When fitting a supply plug ensure that the connections are as follows:

EARTH (ground) - Green/Yellow
NEUTRAL - Blue
LIVE (phase) - Brown

SAFETY TESTING

This product has been safety tested in accordance with BS4743 and IEC Publication 348.

GOODS-IN CHECKS

The following Goods-In Check verifies that the MTS is functioning correctly, but does not verify conformance to the listed specification. To verify that the instrument conforms to the specification given in Chapter 1, refer to Chapter 5, Acceptance Testing.

For the purpose of the Goods-in Check, the instrument's self test facility is used. Self tests are performed by the instrument at power on. If a failure occurs, an error report is written to a self test results store held in non-volatile memory (assuming that the failure does not prevent this). In addition, an error message (marked with the 'system failure' icon) is displayed, i.e.

Self-test failed. Examine power-on test results

To examine the record of the test results, use

[UTILITY]*[Service][Status][Display Test Results]*

If the fault involves the data acquisition system, another, more specific message may be displayed, such as 'Data acquisition main amp failed'. In this case also, the test results should be examined.

In addition, certain hardware failures are reported at power on via the parallel printer port. This allows diagnostic information to be obtained from an instrument which otherwise may appear "dead", e.g. if the graphics system has failed.

Further details of the power-on self tests can be found in the Test Results Menu description in Chapter 3.

If the instrument appears to be completely dead, carry out the following:

Check that the mains power supply line is providing power to the instrument.

Check that the rear panel power supply status LEDs are all OFF.

Check that the rear panel voltage selector switch matches the supply voltage.

Check that the mains fuses have not blown (accessible from the rear panel).

MOUNTING ARRANGEMENTS

Ensure that the air vent and other ventilation holes are not obstructed, otherwise the maximum temperature specification is reduced, resulting in impaired operation. Avoid standing the instrument or associated sensors/detectors in the vicinity of large transformers or other possible magnetic fields.

RACK MOUNTING

The Microwave Test Set may be mounted in a standard 19 inch rack using the rack mounting kit 54127-309 available as an optional accessory. When a 6210 is fitted to the MTS, an additional mounting kit 54127-311 is needed to support the rear. It consists of a rack mounting tray, which is fitted to the rear of the rack, and a front blanking panel. In both cases the bail arm must first be removed.

Note...

A 6200 on its own can be mounted in a standard 19 inch rack which has a minimum depth of 550 mm. With a 6210 fitted, the rack depth must be between 550 mm and 800 mm.

(1) Unclip both end caps and loosen the screws at both sides.

(2) Remove one screw and pull the bail arm away from the indexing mechanism. Remove the remaining screw and remove the bail arm.

(3) If a 6210 is fitted, secure the support tray from kit 54127-311 to the rear of the rack so that it will support the rear of the instrument when it is fitted to the rack.

(4) Fit the rack mounting brackets to the side rails of the instrument using the supplied M5 screws and washers, then fit the instrument into the rack.

(5) If a 6210 is present, and the front blanking plate is fitted, ensure that the painted surface of the plate is on the outside.

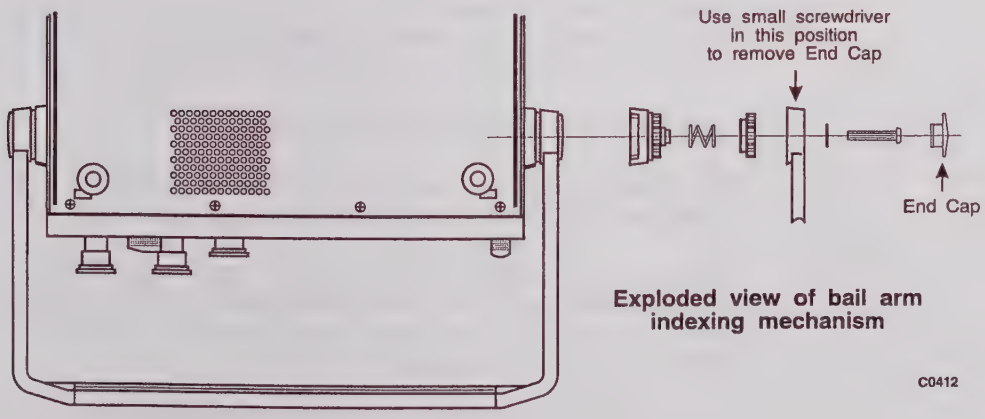

Fig. 2-2 Removal of Bail Arm Prior to Rack Mounting

INSTALLATION OF THE 6210 REFLECTION ANALYZER

The following procedure enables the user to fit a 6210 Reflection Analyzer to a 6200A Series MTS. This will be necessary, for example, if the 6210 was not purchased as part of a 6200A/6210 system, or if the units have had to be separated for servicing purposes.

The Installation Kit supplied with the 6210 comprises the following items:

Description	*Part No.*	*Qty.*
Pillar assembly	41700/616	4
Rear support bar	41700/772	2
Clip, R.H.	35905/447	2
Clip, L.H.	35905/448	2
Tie bar	35907/293	1
Bracket	35907/294	2
Washer, plain, M4	21171/110	2
Screw, pan head, M4 x 10	21833/003	2
Screw, pan head, M4 x 8	21833/008	4
Screw, pan head, M4 x 12	21833/009	2
Screw, pan head, M5 x 40	21837/575	4
Nut, hex, M4	21882/110	2

Refer to Fig. 2-3.

(1) Turn the MTS upside down. Pull off the studs covering the screws which hold the feet in place, and remove the four feet.

(2) Place a clip over one of the holes where a foot was previously located, such that the lug of the clip is located in the slot adjacent to the hole. Note that there are two left hand clips and two right hand clips.

(3) Screw a pillar assembly into the hole so that the clip is tightly secured between the pillar and the bottom cover of the instrument.

(4) Repeat steps (2) and (3) at the other three locations.

(5) Locate the 6210 over the pillar assemblies and screw the feet that were removed in step (1) into the pillar assemblies, thus securing the 6210. Refit the studs.

(6) Remove the two rear supports on one side of the MTS. Discard the screws and plain washers but retain the lockwashers. Using the supplied M5x40 mm screws and the original lockwashers, re-attach the two rear supports together with one of the brackets.

(7) Repeat step (6) at the other side of the instrument.

(8) Attach a rear support bar to each of the brackets using M4x8 mm screws. The top end of the support bar is located in a slot in the upper rear support of the MTS.

(9) Fix the tie bar to the lower end of the support bars using two M4x10 mm screws, nuts and plain washers, and to the rear of the 6210 using two M4x12 mm screws. Note that there is a strip of RF gasket material along one edge of the tie bar; this should be in contact with the bottom rear edge of the 6210.

(10) Connect the four cable assemblies to the appropriate connectors as shown in Fig 2-4, which show the front and rear views of the 6200A/6210 combination.

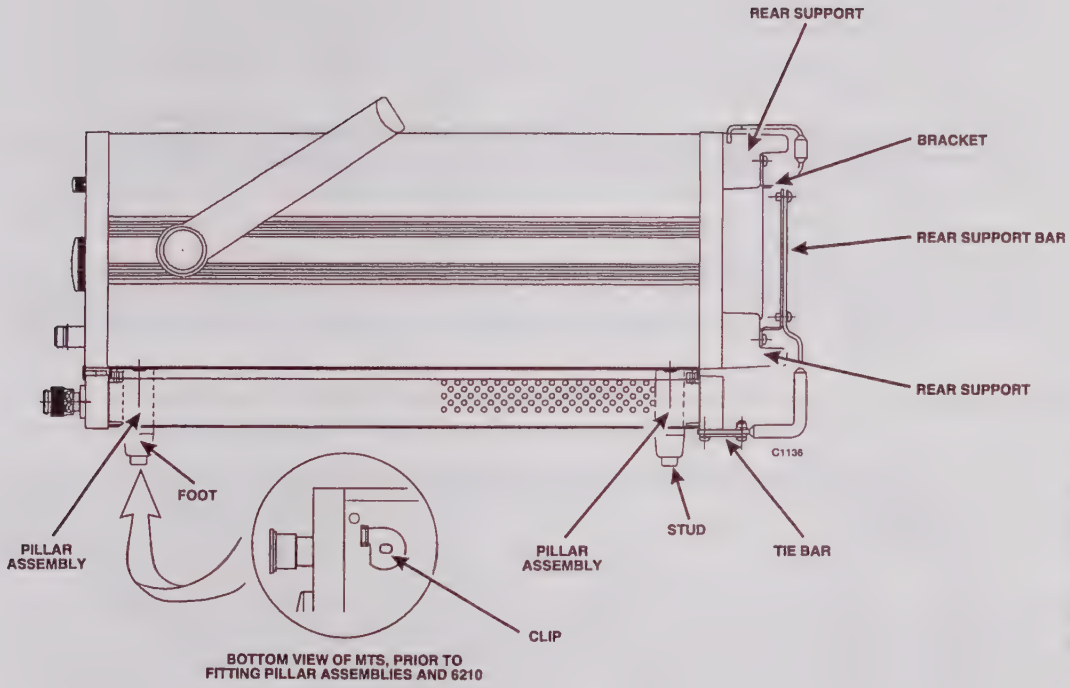

Fig. 2-3 Side View of a 6210 Fitted to the MTS

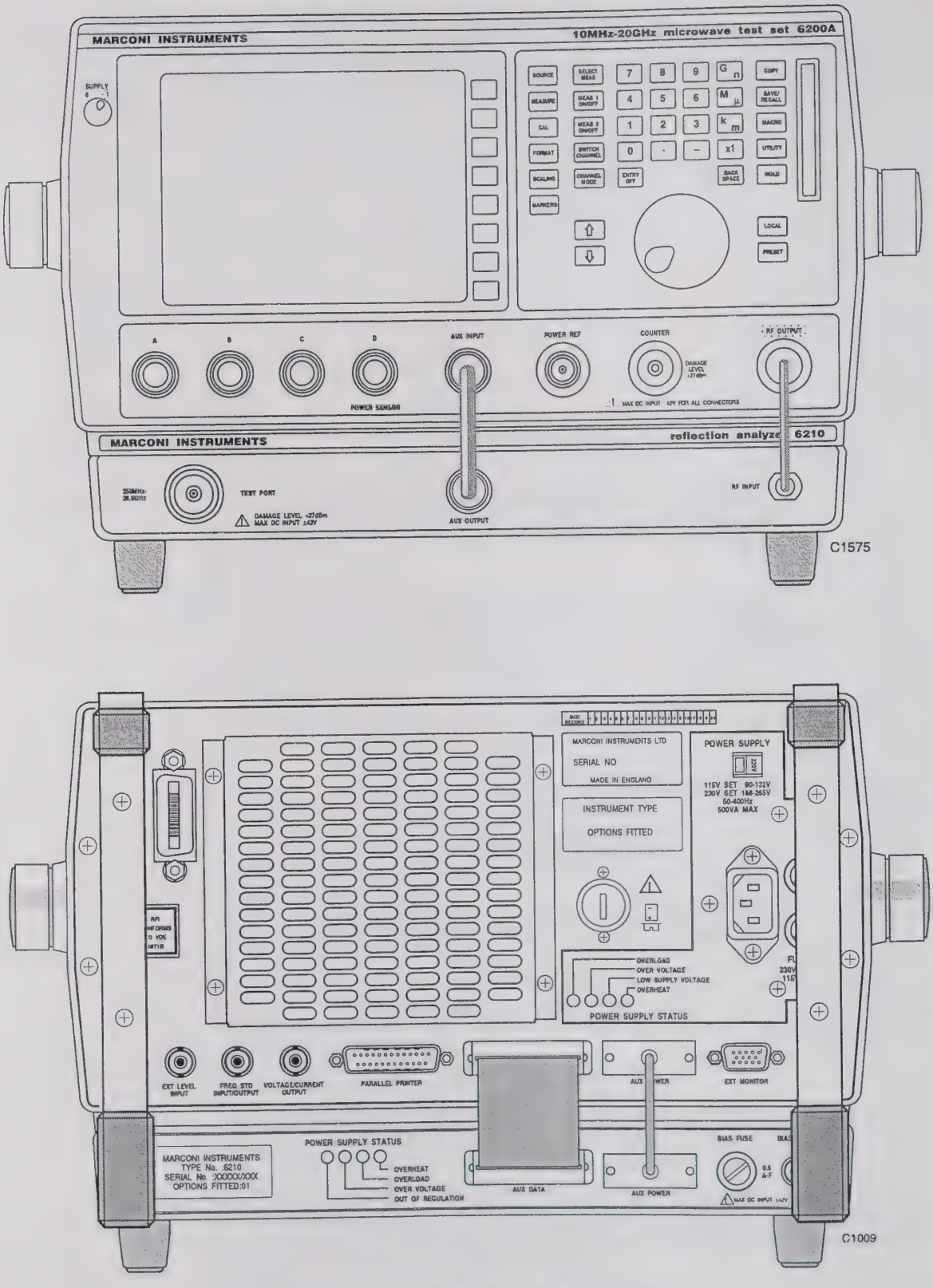

Fig. 2-4 Front and Rear Views of 6200A/6210

ROUTINE MAINTENANCE

Routine maintenance is limited to cleaning the display screen and taking proper care of microwave connectors.

Microwave Connectors

Care should be taken when using microwave connectors, both on the MTS and on any accessories that are used, such as cables, adapters, detectors, test heads, etc. Complying with the following precautionary notes will ensure longer component life and less equipment downtime due to connector or component failure.

- The precision connectors fitted to this equipment and its accessories may be damaged by mating with a non-precision type. Damage to the connectors may also occur if the connector interface parameters are not within specification. This should be checked with the appropriate gauging tool. It is strongly recommended that every connector be gauged prior to its first use and regularly thereafter, e.g. every 20 connections.
- The precise geometry of the connectors can be easily disturbed by dirt and other contamination adhering to connector interfaces. Alcohol is the recommended cleaning agent, and a clean, damp cotton swab is the recommended applicator. When not in use, keep the connectors covered with the protective caps provided.
- Always use the correct mating techniques. In particular, the two connectors to be mated should be pressed together such that the pin penetrates the collet prior to the nut being tightened. Never rotate one connector body relative to the other because this wears out the mating interfaces, thus reducing connector lifetime.
- Avoid over-torquing connectors during mating, because it may damage the connector centre pin or may cause the connector body to turn in its housing. Finger tight is usually sufficient.
- Avoid mechanical shock by dropping or otherwise roughly handling microwave components.

Cleaning the LCD Window

To prevent damage to the LCD window, care should be taken not to scratch the surface during use and also when cleaning. The LCD window should be cleaned by wiping a slightly damp, soft, lint-free cloth gently over the surface. To remove grease or smears, use a clean cotton cloth moistened with Heptane. No other cleaning agents should be used. Clean the window using either horizontal or vertical strokes, NEVER a circular action.

BATTERY REPLACEMENT

Instrument Battery

Both the MTS and the 6210 contain non-volatile memory which is powered by a lithium battery when the power is removed. Although battery life can extend to five years, this will depend on conditions of use, e.g. battery life is reduced as the temperature is increased. To avoid loss of data it is recommended that the battery is replaced every two years.

Replace the MTS battery as follows:

(1) Ensure that the instrument is switched on; this will provide power for the non-volatile memory while the battery is replaced.

(2) Using a coin or suitable tool, unscrew the battery compartment cover at the rear of the instrument.

(3) Remove the battery and insert the replacement, then replace the battery compartment cover.

Replace the 6210 battery as follows:

(1) Ensure that the 6210 is powered up, so that data is not lost while the battery is replaced.

(2) Remove the four feet and the 6 screws that secure the 6210 bottom panel.

(3) The battery is held in clips at the rear of the instrument. When replacing the battery, ensure that the outer plastic skin is not punctured by the clips as the battery is pushed in. Also ensure correct orientation, as indicated by the "+" sign on the board.

The replacement battery should be SAFT L56 or equivalent. This is a Lithium 3.5 V type, rated at 1800 mAH, size AA. A suitable replacement battery can be obtained from Marconi Instruments (Part Number 23711-106Z).

Memory Card Battery

The memory card circuits are powered from its own internal battery when not in use, but are powered from the MTS when the card is inserted into the memory card slot.

As for the instrument battery, the memory card battery should be replaced every two years to ensure data integrity. The battery is replaced as follows:

(1) Insert the card into the memory card slot of a powered-up instrument. This ensures that the card receives power while the battery is replaced.

(2) Remove the small screw at the edge of the card and slide out the battery holder (a suitable screwdriver is supplied with the card).

(3) Remove the battery, insert the replacement and refit the battery holder.

The battery used is either a Lithium type 2016 or 2325, depending on the memory card

Note...

Refer to 'Precautions' at the front of this manual for hazards relating to Lithium batteries.

ROUTINE SAFETY TESTING AND INSPECTION

In the UK the 'Electricity at Work Regulations" (1989) section 4(2) places a requirement on the users of equipment to maintain it in a safe condition. The explanatory notes call for regular inspections and tests together with a need to keep records.

The following electrical tests and inspection information is provided for guidance purposes and involves the use of voltages and currents that can cause injury. It is important that these tests are only performed by competent personnel.

Prior to carrying out any inspection and tests the instruments must be disconnected from the mains supply and all external signal connections removed. All tests should include the instrument's own supply lead, all covers must be fitted and the supply switch must be in the 'ON' position.

The recommended inspection and tests fall into three categories and should be carried out in the following sequence:

1. Visual inspection
2. Earth Bonding Test (Class I equipment only)
3. Insulation Resistance test.

1. Visual Inspection

A visual inspection should be carried out on a periodic basis. This interval is dependant on the operating environment, maintenance and use, and should be assessed in accordance with guidelines issued by the Health and Safety Executive (HSE). As a guide, this instrument when used indoors in a relatively clean environment would be classified as 'low risk' equipment and hence should be subject to safety inspections on an annual basis. If the use of the equipment is contrary to the conditions specified, you should review the safety re-test interval.

As a guide, the visual inspection should include the following where appropriate:

Check that the equipment has been installed in accordance with the instructions provided (e.g. that ventilation is adequate, supply isolators are accessible, supply wiring is adequate and properly routed).

The condition of the mains supply lead and supply connector(s).

Check that the mains supply switch isolates the instrument from the supply.

The correct rating and type of supply fuses.

Security and condition of covers and handles.

Check the supply indicator functions (if fitted).

Check the presence and condition of all warning labels and markings and supplied safety information.

Check the wiring in re-wireable plugs and appliance connectors.

If any defect is noted this should be rectified before proceeding with the following electrical tests.

2. Earth Bonding Tests (Class I Equipment only)

Earth bonding tests should be carried out using a 25A (12V maximum open circuit voltage) DC source. Tests should be limited to a maximum duration of 5 seconds and have a pass limit of 0.1 Ω after allowing for the resistance of the supply lead. Exceeding the test duration can cause damage to the equipment. The tests should be carried out between the supply earth and exposed case metalwork, no attempt should be made to perform the tests on functional earths (e.g. signal carrying connector shells or screen connections) as this will result in damage to the equipment.

3. Insulation Tests

A 500 VDC test should be applied between the protective earth connection and combined live and neutral supply connections with the equipment supply switch in the 'on' position. It is advisable to make the live/neutral link on the appliance tester or its connector to avoid the possibility of returning the instrument to the user with the live and neutral poles linked with an ad-hoc strap. The test voltage should be applied for 5 seconds before taking the measurement. Marconi Instruments products employ reinforced insulation in their construction and hence a minimum pass limit of 7 MΩ should be achieved during this test.

Where a DC power adapter is provided with the instrument the adapter must pass the 7 MΩ test limit.

We do not recommend dielectric flash testing during routine safety tests. Most portable appliance testers use AC for the dielectric strength test which can cause damage to the supply input filter capacitors.

It is recommended that the results from the above tests are recorded and checked during each repeat test. Significant differences between the previous readings and measured values should be investigated.

If any failure is detected during the above visual inspection or tests, the instrument should be disabled and the fault should be rectified by an experienced Service Engineer who is familiar with the hazards involved in carrying out such repairs.

Safety critical components should only be replaced with equivalent parts, using techniques and procedures recommended by Marconi Instruments Ltd.

The above information is provided for guidance only. Marconi Instruments products are designed and constructed in accordance with International Safety Standards such that in normal use they represent no hazard to the operator. Marconi Instruments Ltd reserve the right to amend the above information in the course of continuing its commitment to product safety.

PUTTING INTO STORAGE

IF the instrument is to be put into storage, ensure that the following conditions are maintained:

Temperature range	-40 to +70°C
Humidity	Less than 93% at 40°C

Chapter 3
LOCAL OPERATION

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INTRODUCTION

This chapter explains how to operate the Microwave Test Set using the front panel controls and soft key menus. It provides illustrations and descriptions of the front panel features, the liquid crystal display and its labels, and the rear panel features and connectors. For a functional description and block diagram of the MTS refer to Chapter 4.

FRONT PANEL FEATURES

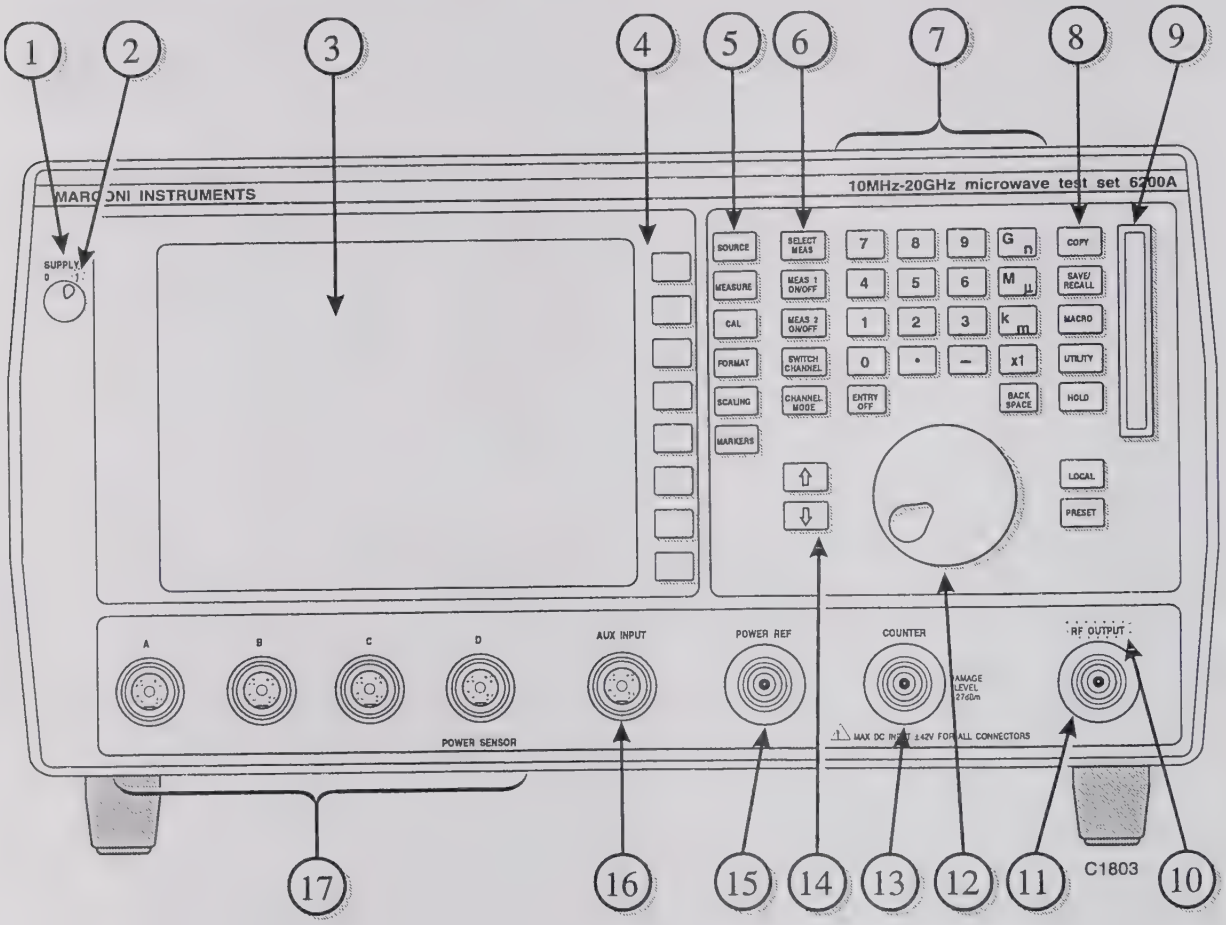


Fig. 3-1 MTS Front Panel

Fig. 3-1 illustrates the following features and function groups of the MTS front panel. These features are described in more detail later in this chapter.

(1) **SUPPLY On/Off Switch.** Controls the AC power to the MTS; clockwise = ON, anti-clockwise = OFF.

(2) **SUPPLY "ON" indicator.** This is an LED which is hidden until lit.

(3) **Liquid Crystal Display.** This is used for display of measurement traces and annotations, soft key labels and other information. The display is divided into specific information areas, explained in detail later in this chapter.

(4) **Soft Keys.** The eight soft keys are used to select the desired control and functional options presented by the various menus accessed through the function, display and system keys located on the front panel.

(5) **Function Keys.** These keys are used to control the signal from the synthesized source, defining the measurement, calibrating the measurement system, formatting and scaling the display and setting up markers. The keys in this group are [SOURCE], [MEASURE], [CAL], [FORMAT], [SCALING] and [MARKERS].

(6) **Display Keys.** These keys determine the number of channels and measurement that are displayed, the channel mode, and which channel or measurement is active. The keys in this group are [MEAS 1 ON/OFF], [MEAS 2 ON/OFF], [SELECT MEAS], [SWITCH CHANNEL] and [CHANNEL MODE].

(7) **Numeric Entry and Terminator Keys.** These keys are used for entering values of numeric parameters and other numeric entries.

(8) **System Keys.** The SYSTEM group keys control system functions including instrument preset, instrument settings save/recall functions, plotter and printer control, setting up the GPIB mode, and built-in diagnostic tests. The front panel keys in this group are [COPY], [SAVE/RECALL], [MACRO], [UTILITY], [HOLD], [LOCAL] and [PRESET].

(9) **Memory Card Slot.** Accepts plug-in memory cards containing non-volatile RAM that can be used for extending the number of instrument stores and installing software options (e.g. Fault Location).

(10) **RF OUTPUT "ON" indicator.** This is an LED which is hidden until lit.

(11) **RF OUTPUT Connector.** This is a precision connector for the RF output signal.

(12) **Rotary Control.** Adjustments may be made to a parameter value using the rotary control.

(13) **COUNTER Connector.** This input is used when measuring the frequency of a signal.

(14) **Step Keys.** The step keys (⇑ and ⇓) are used to step the current value of a parameter up or down.

(15) **POWER REF Connector.** This connector provides a 50 MHz, 1 mW reference signal that is used to calibrate power sensors before taking any measurements.

(16) **AUX INPUT Connector.** This is used to receive detector inputs from the 6210 Reflection Analyzer.

(17) **Input Connectors.** Connectors A, B, C and D accept 12 pin connectors from the detector cable assemblies. Input D can also be configured to accept a power meter sensor when power meter accuracy is required.

FRONT PANEL KEYS AND SOFT KEY MENUS

The functions of the MTS are activated from the front panel by the operator using three groups of specific function keys (Function, Display and System groups), eight soft keys for accessing menu options, a numeric entry key group, a rotary control and step up/down keys.

Some of the more important terms relating to the operation of the instrument are defined below:

INPUT

A front panel scalar detector or power sensor connector. Power measurements are defined in terms of inputs

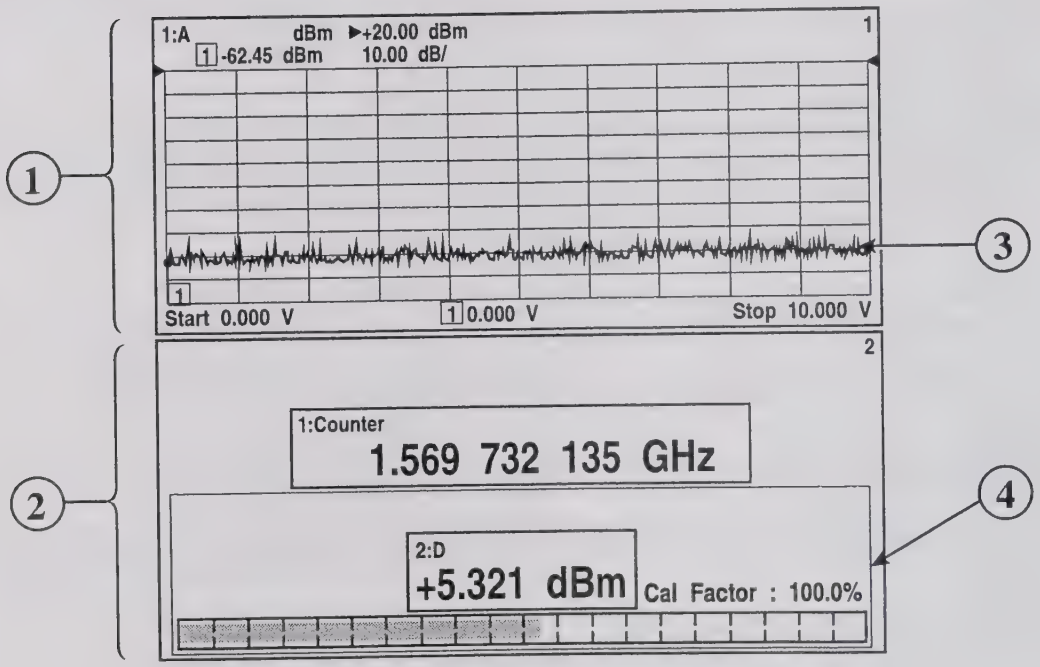
CHANNEL MODE

Determines the type of measurements that the channel displays.

Modes include Scalar, Readout and Fault Location.

CHANNEL COUPLING

Coupled channels share the same source set-up. When uncoupled, they can have independent source set-ups



1 CHANNEL

An area on the screen where measurements are displayed. MTS can display one or two channels.

2 ACTIVE CHANNEL

The channel containing the currently active measurement.

SWITCH CHANNEL: Switches to the other channel, making it active.

3 MEASUREMENT

A trace or readout displayed within a channel. MTS can display one or two measurements per channel.

MEAS 1 ON/OFF: Toggles measurements on or off within the active channel.

MEAS 2 ON/OFF

4 ACTIVE MEASUREMENT

Indicated by red border. A measurement's attributes may be changed when it is active.

SELECT MEAS: Cycles around all the displayed measurements, making each active in turn.

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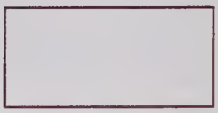
Fig. 3-2 Definition of Terms

Note...

In this manual all front panel keys are shown in brackets, e.g. [SOURCE]; soft key labels are shown in brackets in lower case italic type, e.g. *[Source Functions]*.

The function currently activated is called the active function. As long as a function is active it can be modified with the numeric entry controls (explained later in this chapter). A function remains active until either another function is selected, [ENTRY OFF] is pressed, or the appropriate soft key is pressed that is provided for this purpose.

Front panel keys are used to change instrument functions directly or to provide access to additional functions available in soft key menus. These menus are displayed lists of related functions or choices for a particular function, with each choice corresponding to one of the eight soft keys located to the right of the LCD. Pressing one of the soft keys either executes the labelled function and makes it the active function, or changes the current status of a function, or presents another set of menu labels. The type of action is indicated by the shape of the box enclosing the soft key label, as shown below:



Indicates that selecting the soft key will immediately cause the instrument to perform the designated function, without any further interaction from the user.

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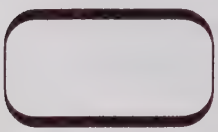
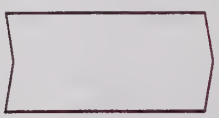
Indicates that, after selecting this soft key, the user will be able to change a parameter. A dialogue box will be displayed on the screen containing a title indicating the parameter being changed, and an input field for entering the new value.

Indicates that selecting this soft key will toggle the indicated item on or off. The box contains a representation of an indicator lamp which 'lights up' to indicate that the item is on.



If the top and bottom edges are highlighted in green, this indicates that, out of two or more possible items, this one has been selected. Pressing it will have no effect, but selecting another of the same group will deselect it. The boxes representing soft keys in the same group are linked together by a vertical line.



Indicates that selecting this soft key will present the user with either a new menu or a dialogue box. The dialogue box is a window displayed on the screen to allow the user to change one or more parameters which make up the entries in the form. The soft keys are used to select, change, add or delete parameters, and various other operations according to the function involved.

This is always the bottom soft key of a menu, and is the 'return' key that returns the user to the previous level of the menu structure.

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Unselectable items are indicated by a dotted outline.

Top level menus, i.e. the ones displayed when a hard key is pressed, are indicated by surrounding the menu title with a box outline.

Most menus allow access to other top level menus simply by pressing the appropriate hard key. The user does not need to return to the top level menu from which the current one is derived. The exceptions to this are the editor menus such as those used for editing detector correction specifications and sensor cal data tables. In these cases, the user must return back to the top level menu by pressing the appropriate return soft keys.

Detailed descriptions of all the MTS menus are given later in this chapter, grouped into three major sections, corresponding to the Display Group, Function Group and System Group keys.

The menu structure associated with the Function Group keys will depend upon the active channel type, e.g. scalar, readout or fault location etc. Since a particular measurement will be associated with one of these channel types, the menus for the keys in this group have been arranged accordingly, for ease of use.

At the start of each menu description is shown the path for that menu, i.e. the key presses the operator must make in order to access the menu. The menu title and soft key labels are listed on the left hand side of the page, exactly as they would be shown on the display. The right hand column contains the descriptions.

Numeric Entry

The numeric keypad, rotary control and step keys are used in conjunction with other front panel keys and soft keys to modify the active entry, to enter or change numeric data, and to change the domain value (i.e x-axis position) of the active marker. In many cases, the keypad, rotary control and step keys can be used interchangeably. Numeric data is entered via a small window displayed in the top left-hand corner of the channel display. In some cases a parameter can be set from the active and delta markers displayed on the active measurement.

Before a function can be modified it must be made the active function by pressing a front panel key or soft key. It can then be modified directly with the step keys or rotary control, or the new value can be entered on the numeric keypad and followed by a terminator as described below.

The Numeric Keypad is used to enter digits, decimal point and minus sign for numeric entries, followed by a units terminator.

The Units Terminator Keys are the four keys to the right of the numeric keypad. These are used to specify the units for numeric entries from the keypad, and at the same time terminate the entries. A numeric entry is incomplete until a terminator is supplied. Some functions, for example where only a single digit entry is required, do not require a terminator. The units are abbreviated on the terminator keys as follows:

G n	=	Giga/Nano ($10^9/10^{-9}$)
M μ	=	Mega/Micro ($10^6/10^{-6}$)
k m	=	kilo/milli ($10^3/10^{-3}$)
×1	=	basic units such as Hz, Volts etc; unitless entries, such as Averaging Number.

Functions can be terminated with any of the above terminator keys. The first three keys represent both positive and negative powers of ten, but the power represented by a particular terminator key at any given time is context dependent. That is, the parameter being changed determines whether positive or negative powers of ten apply (e.g. positive powers apply for frequency, and negative powers for voltage and current).

Some parameters which have a particularly wide range will default to either positive or negative powers of ten, but may be changed by pressing [–] before pressing a terminator key. For example, power in Watts defaults to negative powers of ten (n, μ, m), but positive powers (G,M,k) can be achieved by first pressing [–] before terminating the numeric entry.

Within the menu descriptions, each function requiring numeric entry will indicate the valid terminator by use of the following conventions:

10+ indicates positive powers of ten, including the [×1] key.

10− indicates negative powers of ten, including the [×1] key.

Any indicates that any terminator key can be used.

A small checklist table will be used to indicate which terminators apply for numeric entry, and also whether the step keys or rotary control can be used. An example is shown below:

Rotary Control √	Step Keys √	Numeric Pad √	Terminator 10+

The Rotary Control is used to make continuous adjustments to current values for various functions. The sensitivity and rate of parameter update depends on the parameter being controlled. If the active marker is turned on, and no other function is active, the control can be used to adjust the marker domain value (x-axis position). Values changed by the rotary control are effective immediately, and require no units terminator. The control can also be used to move horizontally between input fields on the displayed forms of certain menus.

The Step Keys (⇑ and ⇓) are used to step the current value of the active function up or down. The step size can be independently set for various parameter types, such as frequency, power and voltage, by accessing the Utility menus. The keys autorepeat when held down. The step keys can also be used to move vertically between input fields on the displayed forms of certain menus.

[ENTRY OFF]. When a numeric entry has been terminated with one of the units keys, the display is updated to reflect the new value. However, the numeric entry form remains to allow the parameter to be further modified, if required. Pressing [ENTRY OFF] removes the form, as well as any displayed prompts, error messages or warnings.

[BACK SPACE] deletes the last digit entered from the numeric keypad.

Parameter Entry Via Marker. Some parameters can be set from the position or response values of the active or active and delta markers displayed on the active measurement. This is done by pressing the soft key for the parameter, positioning the marker, then pressing [×1] on the numeric keypad. The following parameters can be set in this way:

Source start, stop, centre and span frequencies.

Display start, stop, centre and span frequencies.
(Enhance Menu - Fault Location Channel; Display Zoom Menu - Ref Analyzer Channel)

Reference level

Password Protection

Some of the functions accessed through the menus are password protected. A password protected function will prompt the user to enter a numeric authorisation code before the function is activated. There are three levels of password protection:

Primary
User-defined, Level 1
User-defined, Level 2

When entry of a password is required for a function, a form is displayed on the screen indicating the type of password protection. The numbers are not displayed on the screen as they are entered. The entry is terminated with any units key.

Primary Password

The Primary Password is a unique 6-digit authorisation code in the range 100000 to 999999, which is supplied with the instrument. The Primary Password is capable of enabling any password protected function, including the function that allows the user to change the user-defined passwords.

Each instrument leaves the factory with the Primary Password held in the screen title associated with instrument settings store 1. This can be viewed using [SAVE/RECALL] *[View Settings Store].*

This information can be removed for security reasons as follows:

Recall instrument settings store 1 using *[Recall from Store].*

Erase or overwrite the screen title using [UTILITY]*[Titles][Set Screen Title].*

Store the instrument settings back into store 1 using [SAVE/RECALL]*[Save Settings]*[1][×1].

User-defined Passwords

Two levels of user-defined password are provided:

The Level 1 Password is a 4-digit code in the range 1000 to 9999, and protects those functions which cannot affect the instrument's factory calibration.

The Level 2 Password is a 6-digit code in the range 100000 to 999999, and protects the other functions.

DISPLAY

Channels and Measurements

The MTS has two channels for independent measurement and display of data. Two different measurements can be displayed simultaneously on the same channel, for example insertion loss and return loss of a device.

A channel can be defined to be either:

(a) A swept channel, e.g. a scalar channel, fault location channel or reflection analyzer channel. Up to two traces can be displayed on a swept channel.

or

(b) A readout channel, which will be capable of displaying either one or two digital readouts, which may be either a power meter readout or a frequency counter readout.

The display of channels and measurements is controlled using the Display Group keys (see page 3-25).

The MTS provides a facility for channel coupling, which enables parameters for the source and voltage/current output to be set up identically for both channels. See the [SOURCE] key description on page 3-27

Swept Channel

Fig. 3-3 illustrates the screen information area for one swept channel. If only one swept channel is being displayed, it occupies the whole of the screen, but if two channels are displayed, Channel 1 will be displayed in the top half of the screen, and Channel 2 will be similarly displayed in the lower half.

Start Value is the start value of the sweep in units appropriate to the domain of that measurement, e.g. start frequency for a frequency sweep or start power for a power sweep. This value corresponds to the left hand edge of the display graticule. When the source is in centre/span frequency sweep mode, the centre frequency is shown in this location. This value corresponds to the centre frequency graticule line, and is made bolder than the other graticule lines. The frequency value (and also the Stop Value, described below) can be blanked from the display, as described in the Display Set-up Menu, accessed via the [UTILITY] key.

Stop Value is the stop value of the sweep, and corresponds to the right hand edge of the display graticule. When the source is in centre/span frequency sweep mode, the frequency span is shown in this location. For fault location measurements, the stop value will either be the entered range in the normal display mode, or the stop distance when a sub-range is being displayed.

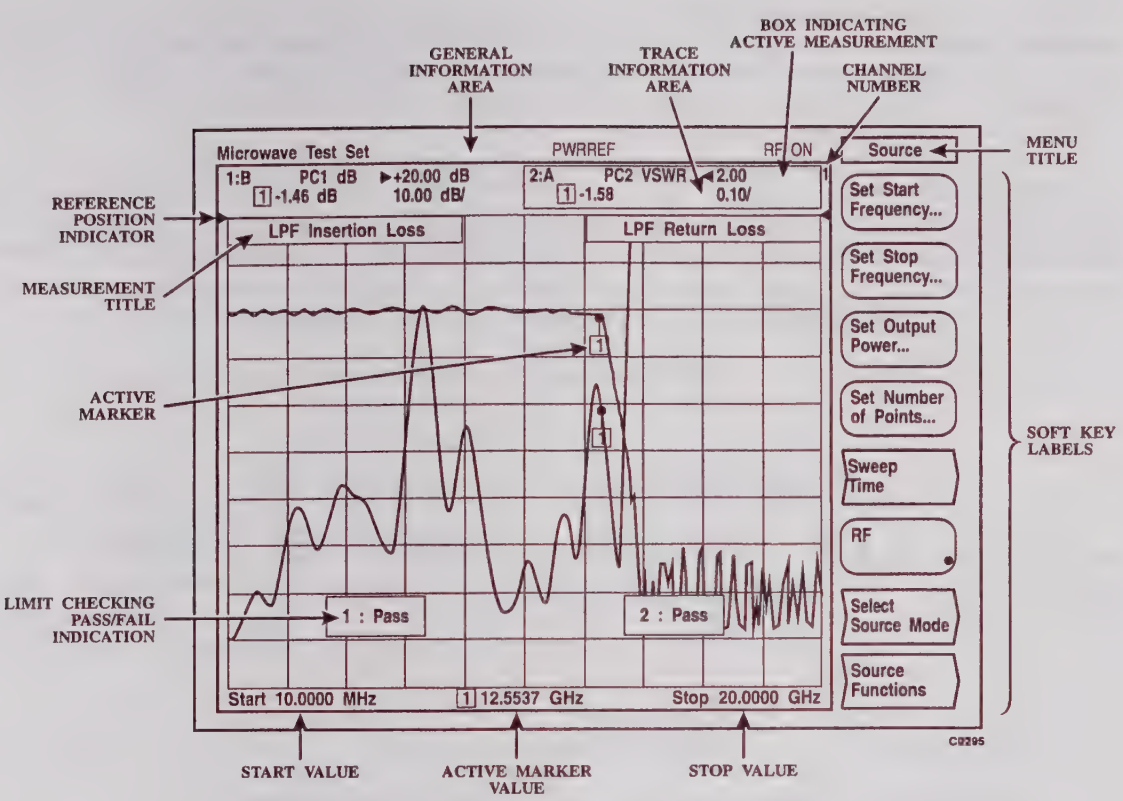


Fig. 3-3 Display - Swept Measurements

Active Marker shows the domain value (x-axis position) of the active marker, in units appropriate to the current measurement. In the delta marker mode, it is the domain value relative to the delta marker position. The measured response at the active marker position is displayed in the relevant Trace Information Area (see below).

Measurement Title is a descriptive alpha-numeric title which is entered by using the Titles Menu, accessed via the [UTILITY] key. If two traces are displayed, the title for measurement 1 appears on the left, and measurement 2 on the right.

Menu Title is the title of the currently displayed menu. If the instrument is set for GPIB (remote) operation, the title is removed and is replaced with the appropriate indicator (see 'General Information Area').

Soft Key Labels are menu labels displayed on the screen that re-define the functions of the soft keys immediately to the right of the screen. The title of the menu is displayed at the top of the menu area to indicate where the user is within the menu structure. See 'Front Panel Keys and Soft Key Menus' for a description of menu operation.

Pass/Fail displays the pass or fail status of a measurement compared to specified limits, as set up using the Lim Checking Menu, accessed via the [MEASURE] key. Each pass/fail window will only be displayed if limit checking is turned on for that trace.

Channel Number indicates which channel is being displayed.

Reference Position Indicator points to the position on the vertical scale which remains fixed during scaling. The indicator for trace 1 is shown to the left of the graticule, in the same colour as trace 1; the indicator for trace 2 is shown on the right. The reference values corresponding to the indicator positions are displayed in the relevant Trace Information Areas (see below). The position and value of the reference position indicator is set using the [SCALING] key.

Markers. Up to eight markers per trace can be set using the [MARKERS] key, to identify specific points of importance on the domain (x) axis of the display and to perform various measurement functions. Markers are denoted by small numbers on the trace, in a colour corresponding to that of the measurement trace. Any of the markers can be enabled to become the active marker (indicated by enclosing the marker number in a box). In addition, a delta marker (represented by Δ) can be set.

Trace Information Area comprises two lines of text indicating what the corresponding trace is displaying. If a trace is turned off, its information will not be present. The trace information area for the currently active measurements is surrounded by a red box outline. A typical example of a trace information area is shown below.

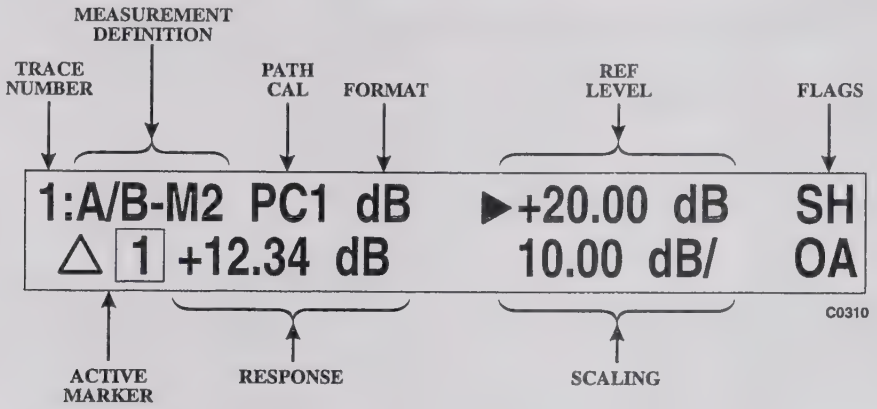


Fig. 3-4 Trace Information Area

Trace Number is the number of the trace (1 or 2) that the information refers to.

Measurement Definition indicates the type of measurement that is being displayed, e.g. single input, ratio, relative to memory, counter etc.

Path Cal indicates that the measurement is relative to the specified path calibration store (PC1 to PC4). For a reflection analyzer channel, the calibration store is indicated by Cal1 etc. A"?" after the calibration identity means that the calibration is not valid; this can occur if certain measurement parameters are changed subsequent to calibration. (See [CAL] key description.)

Format indicates the units of the measurement, e.g. dB, VSWR or Watts, as set up using the menus accessed via the [FORMAT] key. For counter measurements the word 'Freq' is displayed here.

Ref Level is the value corresponding to the position of the associated reference position indicator on the vertical scale. It is preceded by the reference indicator symbol as displayed at the side of the graticule. The Ref Level setting function is accessed via the [SCALING] key.

Flags provide the following information:

S indicates smoothing is being applied to the measurement data.

H indicates that the measurement is held (display frozen).

O indicates that an offset is being applied to at least one input taking part in the measurement. For a reflection analyzer channel this is not relevant, so the 'G' and 'F' flags are shown here instead (see below).

G indicates that gating is being applied to a reflection analyzer measurement. This is displayed in place of the 'O' flag.

F indicates that fencing is being applied to a reflection analyzer measurement. This is displayed in place of the 'O' flag.

A indicates averaging is being applied, and will be in lower case if the average number has not yet reached the target value set by the user through the Averaging Menu ([MEASURE] key).

Active Marker indicates the active marker type:

[1] represents an active marker.
Δ[1] represents active marker in delta mode.

The number within the box denotes the marker which has been designated the active marker.

Response is the value of the measured response at the active marker position, in units appropriate to the current measurement. In the delta marker mode, it is the measured response relative to the response at the delta marker position. For a reflection analyzer channel displaying results in polar or Smith formats, two response values are displayed (i.e. real and imaginary components, or magnitude and phase).

Scaling shows the vertical scaling factor that has been selected, via the [SCALING] key, in units appropriate to the current measurement.

Readout Channel

Fig. 3-5 illustrates the screen information area for one readout channel. The display for a readout channel is split in half horizontally, with Readout 1 in the top half and Readout 2 in the lower. If a readout is turned off, the relevant display area is blank. If two channels are displayed, Channel 1 information will be displayed in the top half of the screen, and Channel 2 will be similarly displayed in the lower half.

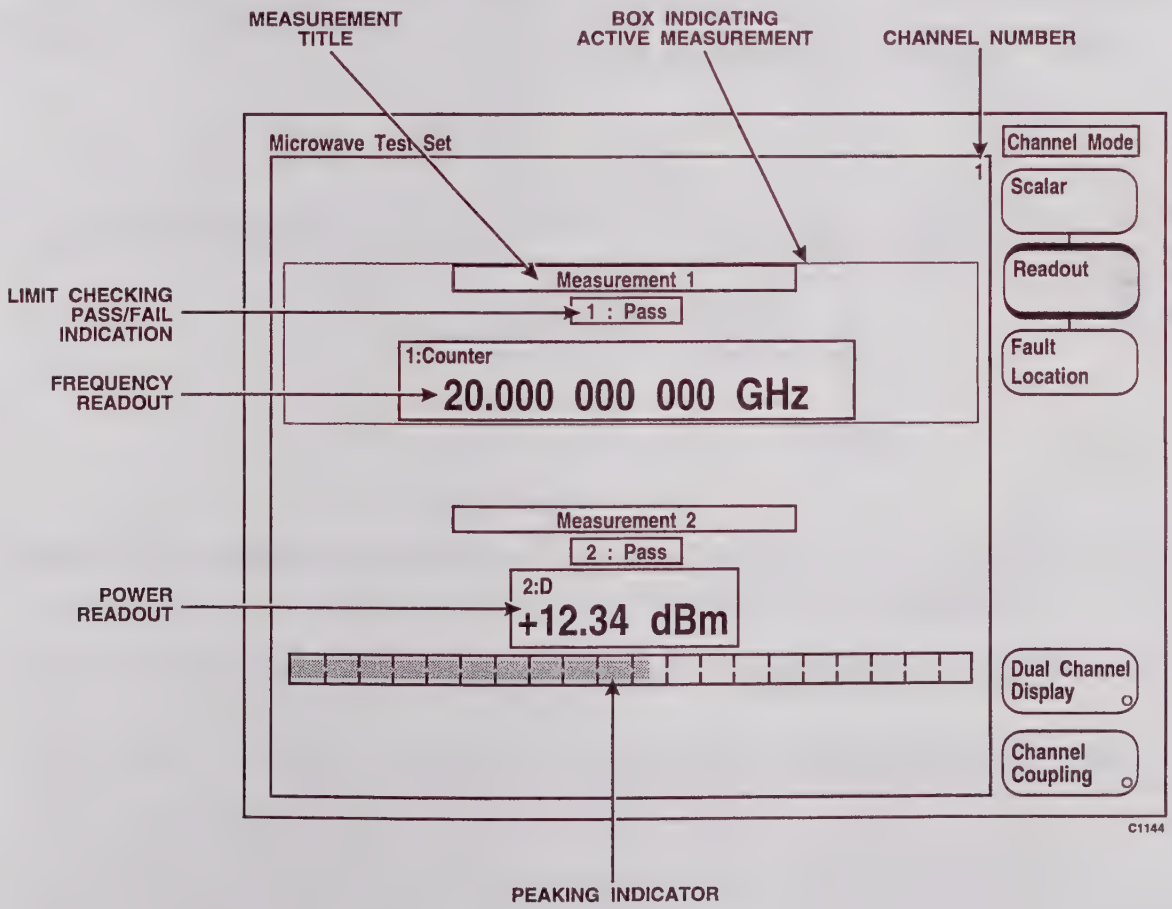


Fig. 3-5 Display - Readout Measurements

Channel Number indicates which channel is being displayed.

Measurement Title is a descriptive alpha-numeric title which is entered by using the Titles Menu, accessed via the [UTILITY] key.

Pass/Fail displays the pass or fail status of a measurement, in the same way as for a swept channel, described earlier.

Readout. The format of the readout depends on whether it is displaying a power meter or frequency measurement. In both cases the readout consists of a readout in large digits together with associated information. Power meter readings are displayed to a maximum of four significant figures with the display resolution selectable between 0.001 and 1 dB in decade steps. The display resolution of frequency readings is selectable between 1 Hz and 100 MHz in decade steps. The readout for the currently active measurement is surrounded by a red box outline. The two formats are shown in Fig. 3-6.

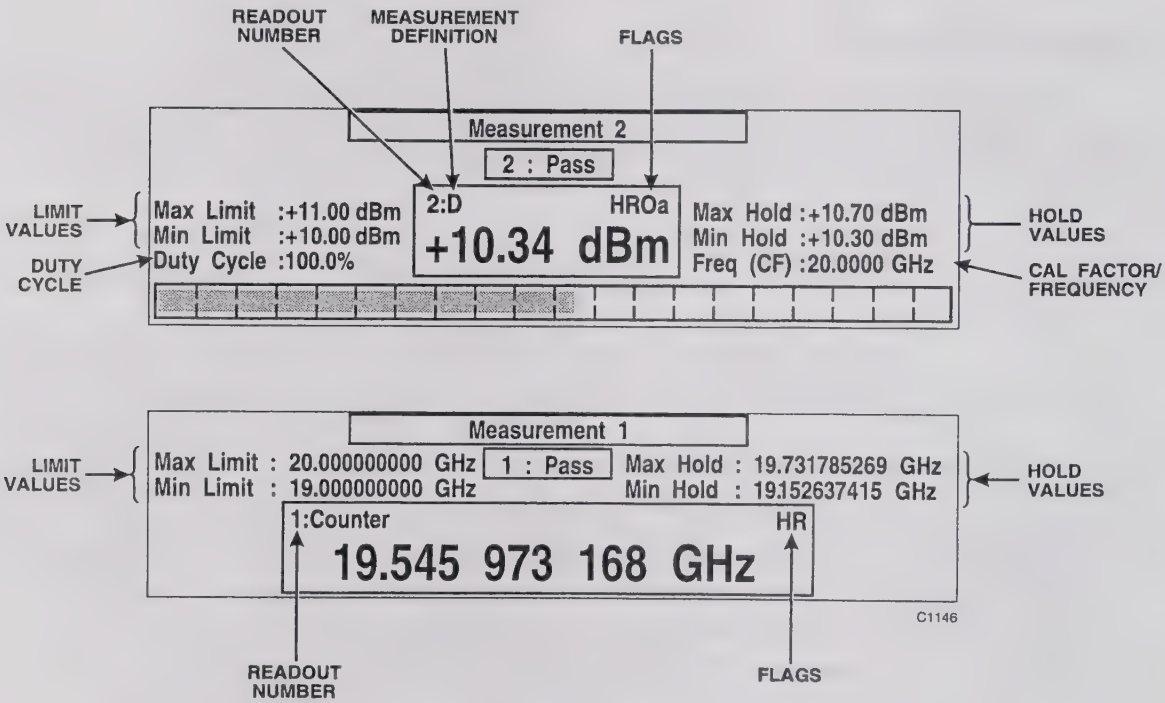


Fig. 3-6 Format of Readout

Limit Values. These are the maximum and minimum values used for limit checking, as set up using the Lim Checking Menu, accessed via the [MEASURE] key.

Hold Values. These are the maximum and minimum values the readout has reached whilst the max/min hold function has been turned on (via the [MEASURE] key).

Duty Cycle. This is the value that is being used in the duty cycle correction that is being applied to the power reading measurement, as set up using the Duty Cycle Menu, accessed via the [MEASURE] key.

Cal Factor/Frequency. This is only applicable if input D has been configured to take a power sensor. If the user has set a cal factor manually, the value is displayed here (labelled Cal Factor). If the cal factor has been chosen from a table using a manually entered frequency, or coupled to the active marker, the corresponding frequency is shown here (labelled Freq(CF)). If the device connected is a scalar detector, then the field is blank because these devices are not cal factor corrected.

Readout Number, Measurement Definition and Flags. The readout number (1 or 2) is followed by an indication of the measurement definition, e.g. single input, ratio or difference. Flags provide the following information:

H indicates that the measurement is held (display frozen).

R indicates a relative measurement.

O indicates that an offset is being applied to at least one of the inputs (power measurements only).

A indicates that averaging is being applied to at least one of the inputs. It is in lower case when the Average Number for at least one input has not yet reached the target value. This flag applies to power measurements only.

Peaking Indicator. This is a horizontal bar whose length varies depending upon the value of the power readout, and also on the value it was centred at (using the *[Reset Peak Indicator]* soft key of the Measure Menu). This analogue representation is not for measurement, but enables changes in the measurement to be seen more easily than with the digital display. The dynamic range of the indicator is approximately 10 dB.

General Information Area

This area is located at the top of the screen, and provides the user with general information concerning the measurement in progress. It is displayed in the format shown in Fig. 3-7.

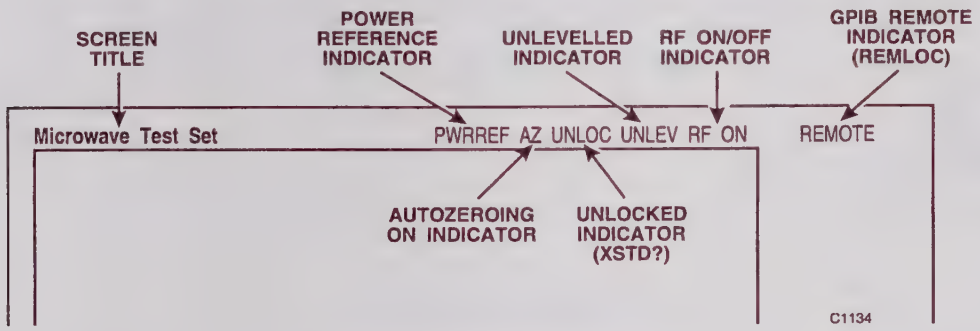


Fig. 3-7 General Information Area

Screen Title is the title of the screen which is entered by using the Titles Menu, accessed via the [UTILITY] key.

Power Reference On Indicator (PWRREF) will be present if the power reference is switched on.

RF On Indicator (RF ON/RF OFF) indicates whether the synthesized source RF is on or off. If it is on, RF ON is displayed in red; if it is off, RF OFF is displayed in blue.

Unlocked Indicator (UNLOC) and External Standard State Indicator (XSTD?) UNLOC indicates that the frequency of the source is unlocked. XSTD? is displayed in this position if the instrument is set up for an external standard, but there is either no standard detected or it is the wrong frequency.

Detector Autozeroing On Indicator (AZ) indicates that detector autozeroing has been enabled.

Unlevelled Indicator (UNLEV) indicates that the source power is unlevelled.

GPIB Remote Indicator (REMOTE) indicates that the instrument is in the GPIB remote state. REMLOC is displayed if this is also local lockout mode, i.e. the front panel controls are locked out. The indicator is displayed in the area that would otherwise be used for displaying the menu title. When the instrument is returned to local mode, the indicator is removed and the menu title is again displayed.

Error Messages

During operation of the MTS, one of several types of error message may be displayed on the screen. The message gives a description of the problem that has occurred and, where appropriate, the action that the operator can take to solve the problem. Appendix B lists all the possible error messages that the operator can receive.

Display Set-up

Facilities are provided to set the screen brightness and screen timeout for the LCD. The screen brightness can be set to either full or half brightness. The timeout facility enables the LCD backlight to be turned off automatically after a specified period of time. These functions are available from the Display Set-up Menu, accessed via the [UTILITY] key.

REAR PANEL FEATURES

Fig. 3-8 illustrates the following features and connectors of the rear panel

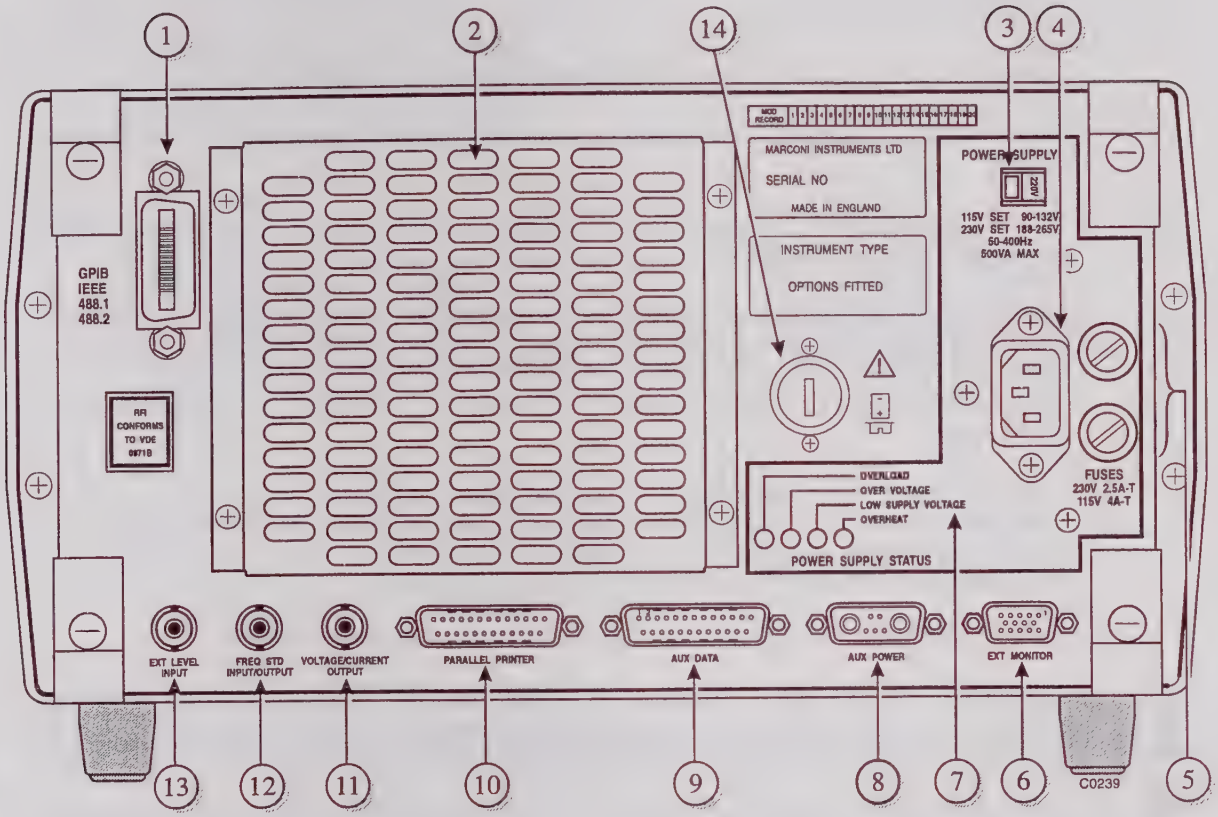


Fig. 3-8 MTS Rear Panel

(1) **GPIB Connector.** Connects the MTS to an external controller when the instrument is to be controlled through the GPIB. This connector is also used when the MTS is required to control a second MTS or an HPGL plotter. Refer to the GPIB Operating Manual for information on GPIB operation.

(2) **Cooling Fan.** The fan extracts the warm air generated by the instrument; it does not contain a filter as it is not necessary with this type of cooling.

(3) **Supply Voltage Selector Switch.** This selects the AC supply voltage range. For more information refer to Chapter 2.

(4) **Power Input Connector.** This is the connector for the AC mains power cable.

(5) **Fuses.** For protection of the line and neutral lines of the supply input. The fuses are rated at 2.5A - T for 188 - 265 V operation, or 4A - T for 90 - 133 V operation.

(6) **EXT MONITOR Connector.** This is used to connect a variable scan rate RGB colour monitor, if required.

(7) **Power Supply Status.** Four LEDs indicate the following fault conditions within the instrument's power supply:

Overload
Over voltage
Low supply voltage
Overheat

If any of the LEDs illuminate, refer to the Maintenance Manual for remedial action.

(8) **AUX POWER Connector.** This is used to provide a 25 V DC supply for the 6210 Reflection Analyzer

(9) **AUX DATA Connector.** This is used to transfer digital data between the MTS and the AUX DATA port of the 6210 Reflection Analyzer.

(10) **PARALLEL PRINTER Connector.** This is used to connect a suitable printer via the Centronics interface. Recommended printers are listed in Chapter 1, "Associated Equipment".

(11) **VOLTAGE/CURRENT OUTPUT Connector.** This output can be defined by the user to be one of the following:

Voltage proportional to the synthesized source output frequency (i.e. Volts/GHz).
Voltage proportional to the power measured by the MTS, which is used to drive a chart recorder.
Swept voltage or current for voltage/current domain measurements.
Fixed voltage or current output for measurements with differing bias.

For details on how to configure this output refer to the V/I Output Menu (page 3-39).

(12) **FREQ STD INPUT/OUTPUT Connector.** This BNC connector provides either a 10 MHz output derived from the internal frequency standard, or accepts either a 1 or 10 MHz input from an external standard, as selected from the front panel (refer to the Lev & F Std Menu, page 3-37).

(13) **EXT LEVEL INPUT Connector.** Provides for the connection of a remote detector or power sensor for source levelling.

(14) **Battery Compartment Cover.** Removal of this cover provides access to the Lithium battery that is used to power the instrument's non-volatile memory.

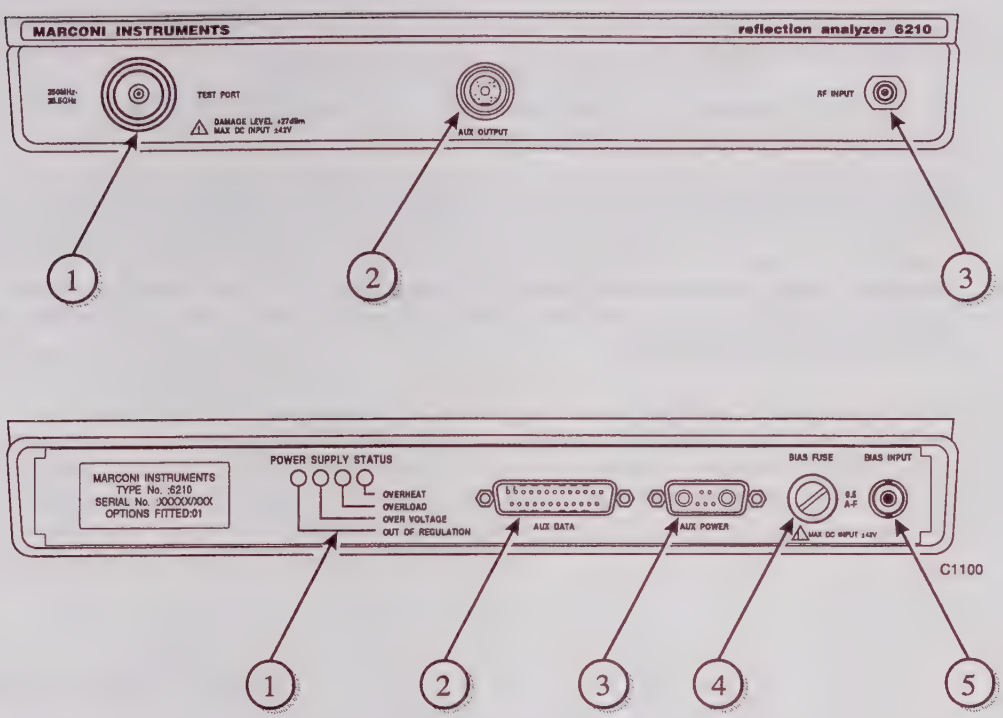


Fig. 3-9 6210 Front and Rear Panels

6210 FRONT PANEL FEATURES

(1) **TEST PORT Connector.** This is a ruggedised 3.5 mm connector for connection to the device under test.

(2) **AUX OUTPUT Connector.** This connector is used to route the four 6210 detector outputs to the AUX INPUT connector of the MTS.

(3) **RF INPUT Connector.** This is a precision 3.5 mm connector for the RF output signal from the MTS.

6210 REAR PANEL FEATURES

(1) **Power Supply Status.** Four LEDs indicate the following fault conditions within the instrument's power supply:

Overload
Over voltage
Low supply voltage
Overheat

If any of the LEDs illuminate, refer to the Maintenance Manual for remedial action.

(2) **AUX DATA Connector.** This is used to transfer digital data between the 6210 and the AUX DATA port of the MTS.

(3) **AUX POWER Connector.** This connects the AUX POWER output of the MTS which provides 25 V DC for the 6210 power supply.

(4) **Bias Fuse.** For protection of the bias input. The fuse is rated at 0.5 A. (This is only present on instruments which have the Bias Tee Option fitted.

(5) **BIAS INPUT Connector.** Provides for the input of a bias voltage, which the 6210 applies to the test port centre pin. The bias voltage can be obtained from the VOLTAGE/CURRENT OUTPUT connector at the rear of the MTS. **The voltage source must be removed from the BIAS INPUT connector whilst any calibration pieces are connected to the 6210, otherwise damage to the calibration pieces may occur. (The BIAS INPUT Connector is only present on instruments which have the Bias Tee Option fitted.**

DISPLAY GROUP KEYS

The keys in this group determine how many measurements will be displayed, and the type of measurement that is to be performed by the currently active channel. Only the [CHANNEL MODE] key has an associated menu structure.

[SELECT MEAS] KEY

The [SELECT MEAS] key is used to select one of the displayed measurements to be the active measurement within the active channel. This is the trace or readout currently controlled by the front panel keys, and all measurement specific functions apply to the active measurement. Pressing this key cycles through the displayed measurements, making each one in turn the active measurement, which is indicated by surrounding the trace information area or readout with a red box outline. The currently displayed menu will change to the equivalent menu for the type of the new active measurement.

[MEAS 1 ON/OFF] KEY

The [MEAS 1 ON/OFF] key has a toggle active which determines whether or not Measurement 1 of the selected channel will be displayed. Since at least one measurement must be displayed in a channel, turning off Measurement 1 with only this measurement displayed will automatically turn on Measurement 2.

[MEAS 2 ON/OFF] KEY

The [MEAS 2 ON/OFF] key has a toggle active which determines whether or not Measurement 2 of the selected channel will be displayed. Since at least one measurement must be displayed in a channel, turning off Measurement 2 with only this measurement displayed will automatically turn on Measurement 1.

[SWITCH CHANNEL] KEY

The [SWITCH CHANNEL] key selects either Channel 1 or Channel 2 to be the active channel. This is the channel currently controlled by the front panel keys. All channel-specific functions apply to the active channel. When the key is pressed, the box outline surrounding the selected channel momentarily brights up in green, to provide an indication to the user that the channel has changed. The currently displayed menu will change to the equivalent menu for the mode of the new active channel.

[CHANNEL MODE] KEY

The [CHANNEL MODE] key presents the Channel Mode Menu, which enables the channel mode to be selected for the currently active channel. It also allows selection of dual channel display and channel coupling.

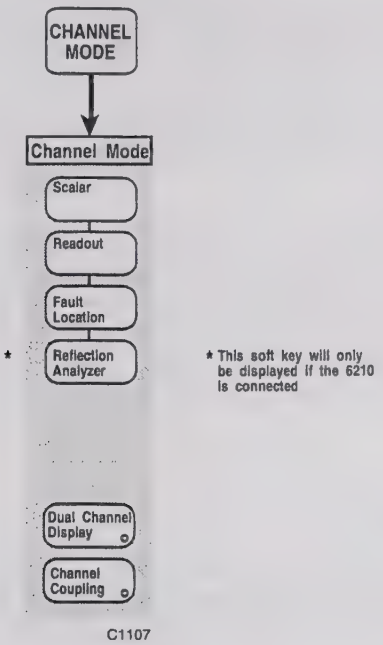


Fig. 3-10 Channel Mode Menu

CHANNEL MODE

Channel Mode .

Scalar Makes the currently active channel a scalar channel.

Readout Makes the currently active channel a readout channel.

Fault Location Makes the currently active channel a fault location channel.

Reflection Analyzer Makes the currently active channel a reflection analyzer channel. This soft key will only be displayed if 6210 Reflection Analyzer is connected.

Dual Channel Display Toggles between dual channel and single channel display.

Channel Coupling Toggles the channel coupling facility on or off.
This soft key is unselectable if the channel types are different.
See page 3-27 for an explanation of channel coupling.

[SOURCE] KEY

The [SOURCE] key provides access to the series of menus illustrated in Figs. 3-11 to 3-14, which are used to define and control all the source functions, e.g. the synthesized sweep generator and the programmable voltage/current output. When the [SOURCE] key is pressed, the Source Menu is displayed; this in turn provides access to the other soft key menus.

The *[Select Source Mode]* soft key is used to access the Source Mode Menu, and the required source mode is then selected by pressing the appropriate soft key. Pressing *[Return to Source]* will return the user to the source menu corresponding to the selected mode. There are therefore six source menus available for a scalar channel, one for each of the source modes that can be selected from the Source Mode Menu. The source modes available are:

Start & Stop Frequency Sweep Mode (linear frequency sweep between user-defined start and stop values).

Centre & Span Frequency Sweep Mode (linear frequency sweep defined by its centre frequency and span).

CW Mode (continuous wave output at a user-defined frequency and power).

Power Sweep Mode (power sweep between user-defined start and stop values).

Voltage Sweep Mode (voltage sweep between user-defined start and stop values).

Current Sweep Mode (current sweep between user-defined start and stop values).

The last three soft keys of the Source Menu are the same for each variant; the remaining five will vary to reflect the parameters required for the particular source mode.

Menus that occur more than once within the Source menu structure (e.g. Source Mode Menu and Source Funcs Menu) are described only once. For subsequent occurrences, a reference is made to the relevant part of the chapter.

The above applies to both the instrument's internal source and to an external source (e.g. a second MTS). If an external source is connected, it is set up by accessing the Int/Ext Source Menu ([Source] *[Source Functions][Int/Ext Source]*) and selecting *[Ext Source Set-up]*. The same functions are then available as for the internal source set up, except that the menus make reference to the external source rather than the internal one.

Channel Coupling

In many applications, there may be a requirement that the RF source set-up and the rear panel voltage/current output be the same for both channels. This can be achieved by setting channel coupling on from the Channel Mode Menu. When channels are coupled, the instrument will ensure that the RF source and voltage/current output are set up identically for both channels.

When channel coupling is first switched on, the RF source and voltage/current settings defined for the active channel will be duplicated for the other channel. Afterwards, any changes made to the source or voltage/current output on the active channel will be reflected in the other channel.

Should it be necessary to have independent source set-ups for each channel, channel coupling can be switched off.

Source (Start/Stop Frequency Sweep Mode)

See Fig. 3-11. **This menu enables the operator to set up the source to provide a linear frequency sweep between the start frequency and stop frequency values. If channel coupling is on (see Source Funcs Menu), the settings defined for the active channel will be duplicated on the other channel. See page 3-27 for an explanation of channel coupling and how sweep modes are selected.**

The start and stop frequencies can also be set to the frequency value corresponding to the position of the active marker on the active measurement. This is done by pressing the appropriate soft key, positioning the active marker on the trace, then pressing the [×1] key on the numeric keypad.

Set Start Frequency

Used to change the start frequency of the source for the currently active channel to a value within the range permitted for the particular MTS.

Rotary Control	√	Step Keys	√	Numeric Pad	√	Terminator	10+

Set Stop Frequency

Similar to the above but applies to the stop frequency of the sweep.

Set Output Power

Used to change the output power of the source for the active channel.

Rotary Control	√	Step Keys	√	Numeric Pad	√	Terminator	Any

Set Number of Points

Used to change the number of measurement points generated by the sweep for the currently active channel, up to a maximum of 1601 points.

Rotary Control	√	Step Keys	√	Numeric Pad	√	Terminator	Any

Sweep Time

Leads to the Sweep Time Menu, which enables the sweep time to be set up manually or automatically.
See page 3-34.

RF

Toggles the RF output on or off.

Select Source Mode

Leads to the Source Mode Menu, which enables CW operation or one of several sweep modes to be selected.
See page 3-35.

Source Functions

Leads to the Source Funcs Menu, which enables several options to be selected, allowing the source to be set up according to the requirements of a particular measurement.
See page 3-36.

Source (Centre/Span Frequency Sweep Mode)

See Fig. 3-12. **This menu enables the operator to set up the source to provide a linear frequency sweep by defining the centre and span of the sweep. If channel coupling is on (see Source Funcs Menu), the settings defined for the active channel will be duplicated on the other channel. See page 3-27 for an explanation of channel coupling and how sweep modes are selected.**

The centre and span values of the frequency sweep can also be set from the positions of the active and delta markers displayed on the active measurement. To set the centre value, press *[Set Cntr Frequency]*, position the active marker, then press the [×1] key on the numeric keypad. To set the span, press the *[Set Span]* soft key, position the delta marker to he appropriate point either side of the centre, then press the [×1] key. (If necessary, enable the delta marker from the Markers Menu.)

Set Cntr Frequency

Used to change the centre frequency of the sweep for the currently active channel to a value within the range permitted for the particular MTS.

Rotary Control √	Step Keys √	Numeric Pad √	Terminator	10+

Set Span

Similar to the above but applies to the span of the frequency sweep.

Set Output Power

Used to change the output power of the source for the currently active channel.

Rotary Control √	Step Keys √	Numeric Pad √	Terminator	Any

Set Number of Points

Used to change the number of measurement points generated by the sweep for the currently active channel, up to a maximum of 1601 points.

Rotary Control √	Step Keys √	Numeric Pad √	Terminator	Any

Sweep Time

Leads to the Sweep Time Menu, which enables the sweep time to be set up manually or automatically.
See page 3-34.

RF

Toggles the RF output on or off.

Select Source Mode

Leads to the Source Mode Menu, which enables CW operation or one of several sweep modes to be selected.
See page 3-35.

Source Functions

Leads to the Source Funcs Menu, which enables several options to be selected, allowing the source to be set up according to the requirements of a particular measurement.
See page 3-36.

Source
(CW Mode)

See Fig. 3-12. **This menu enables the operator to set up the source to provide a continuous wave (CW) frequency. If channel coupling is on (see Source Funcs Menu), the settings defined for the active channel will be duplicated on the other channel. See page 3-27 for an explanation of channel coupling and how sweep modes are selected.**

Note that the CW Mode is not suitable for measurements when the MTS is to be used as an independent source. The Source Only Mode (see page 3-36) should be used in these cases. The *[CW]* soft key description on page 3-35 give a full explanation of the difference between these two modes.

Set Frequency

Used to change the CW frequency of the source for the currently active channel to a value within the range permitted for the particular MTS.

Rotary Control √	Step Keys √	Numeric Pad √	Terminator	10+

Set Output Power

Used to change the output power of the source for the currently active channel.

Rotary Control √	Step Keys √	Numeric Pad √	Terminator	Any

Sweep Time

This soft key is unselectable in CW mode.

RF

Toggles the RF output on or off.

Select Source Mode

Leads to the Source Mode Menu, which enables CW operation or one of several sweep modes to be selected.
See page 3-35.

Source Functions

Leads to the Source Funcs Menu, which enables several options to be selected, allowing the source to be set up according to the requirements of a particular measurement.
See page 3-36.

Source
(Power Sweep)

See Fig. 3-13. **This menu enables the operator to set up the source to provide a linear power sweep between the start power and stop power values. The settable power levels and power sweep range are given in the Performance Data section of Chapter 1.. If channel coupling is on (see Source Funcs Menu), the settings defined for the active channel will be duplicated on the other channel. See page 3-27 for an explanation of channel coupling and how sweep modes are selected.**

Set Start Power

Used to change the start power level of the source for the currently active channel.

Rotary Control √	Step Keys √	Numeric Pad √	Terminator	Any

Set Stop Power

Used to change the stop power level of the source for the currently active channel.

Rotary Control √	Step Keys √	Numeric Pad √	Terminator	Any

Set Frequency

Used to change the CW frequency of the source for the currently active channel to a value within the range permitted for the particular MTS.

Rotary Control √	Step Keys √	Numeric Pad √	Terminator	10+

Set Number of Points

Used to change the number of measurement points generated by the sweep for the currently active channel, up to a maximum of 1601 points.

Rotary Control √	Step Keys √	Numeric Pad √	Terminator	Any

Sweep Time

Leads to the Sweep Time Menu, which enables the sweep time to be set up manually or automatically.
See page 3-34.

RF

Toggles the RF output on or off.

Select Source Mode

Leads to the Source Mode Menu, which enables CW operation or one of several sweep modes to be selected.
See page 3-35.

Source Functions

Leads to the Source Funcs Menu, which enables several options to be selected, allowing the source to be set up according to the requirements of a particular measurement.
See page 3-36.

Source
(Voltage Sweep)

See Fig. 3-14. **This menu enables the operator to set up the source to provide a linear voltage sweep between the start voltage and stop voltage values. The voltage sweep is available at the rear panel VOLTAGE/CURRENT OUTPUT connector. The voltage sweep range is given in the Performance Data section of Chapter 1. If channel coupling is on (see Source Funcs Menu), the settings defined for the active channel will be duplicated on the other channel. See page 3-27 for an explanation of channel coupling and how sweep modes are selected.**

Set Start Voltage

Used to change the start voltage of the source for the currently active channel.

Rotary Control √	Step Keys √	Numeric Pad √	Terminator	10–

Set Stop Voltage

Used to change the stop voltage of the source for the currently active channel.

Rotary Control √	Step Keys √	Numeric Pad √	Terminator	10–

CW Set-up

Leads to the CW Set-up Menu, which enables the source frequency and output power to be set up.
See page 3-42.

Set Number of Points

Used to change the number of measurement points generated by the sweep for the currently active channel, up to a maximum of 1601 points.

Rotary Control √	Step Keys √	Numeric Pad √	Terminator	Any

Sweep Time

Leads to the Sweep Time Menu, which enables the sweep time to be set up manually or automatically.
See page 3-34.

RF

Toggles the RF output on or off. It will not be possible to obtain RF output while a frequency counter measurement is being made, although the soft key is still selectable.

Select Source Mode

Leads to the Source Mode Menu, which enables CW operation or one of several sweep modes to be selected.
See page 3-35.

Source Functions

Leads to the Source Funcs Menu, which enables several options to be selected, allowing the source to be set up according to the requirements of a particular measurement.
See page 3-36.

Source
(Current Sweep)

See Fig. 3-14. **This menu enables the operator to set up the source to provide a linear current sweep between the start current and stop current values. The current sweep is available at the rear panel VOLTAGE/CURRENT OUTPUT connector. The current sweep range is given in the Performance Data section of Chapter 1. If channel coupling is on (see Source Funcs Menu), the settings defined for the active channel will be duplicated on the other channel. See page 3-27 for an explanation of channel coupling and how sweep modes are selected.**

Set Start Current

Used to change the start current of the source for the currently active channel.

Rotary Control √	Step Keys √	Numeric Pad √	Terminator	10⁻

Set Stop Current

Used to change the stop current of the source for the currently active channel.

Rotary Control √	Step Keys √	Numeric Pad √	Terminator	10⁻

CW Set-up

Leads to the CW Set-up Menu, which enables the source frequency and output power to be set up (see previous menu).
See page 3-42.

Set Number of Points

Used to change the number of measurement points generated by the sweep for the currently active channel, up to a maximum of 1601 points.

Rotary Control √	Step Keys √	Numeric Pad √	Terminator	Any

Sweep Time

Leads to the Sweep Time Menu, which enables the sweep time to be set up manually or automatically.
See page 3-34.

RF

Toggles the RF output on or off. It will not be possible to obtain RF output while a frequency counter measurement is being made, although the soft key is still selectable.

Select Source Mode

Leads to the Source Mode Menu, which enables CW operation or one of several sweep modes to be selected.
See page 3-35.

Source Functions

Leads to the Source Funcs Menu, which enables several options to be selected, allowing the source to be set up according to the requirements of a particular measurement.
See page 3-36.

Sweep Time

See Fig. 3-11. **The sweep time is the time taken for the source to complete one sweep, excluding retrace time and the time required for internal processing of the data. The setting determined by this menu will apply instrument-wide, i.e. to all displayed traces.**

Longer sweep times may be necessary when testing certain devices, and also have the effect of reducing noise.

Automatic Sweep Time

Sets the sweep time mode of the source to automatic. In this mode the sweep time automatically adjusts to the minimum sweep time available for the set frequency span and number of measurement points.

User Set Sweep Time

Sets the sweep time mode to manual; the following soft key can then be pressed to allow the sweep time to be changed by the operator.

Set Sweep Time

Allows the sweep time to be entered; the allowable range of values is given in the Performance Data section of Chapter 1. The MTS will generate an actual sweep time that will never be faster than the sweep time entered, but may be slower depending on constraints imposed by the number of measurement points, source frequency range and measurement definition.
This key will only be selectable if manual sweep time mode has been selected

Rotary Control √	Step Keys √	Numeric Pad √	Terminator 10–

Return to Source

Returns control to the Source Menu.

Source Mode

See Fig. 3-11. **This menu enables the MTS source to be set up to provide either a CW (continuous wave) output or a swept output. For swept measurements, the variable that is swept (domain) is plotted on the x-axis of the channel graticule. The frequency, power, voltage and current domains are supported. If two traces are displayed on the same channel, or if the two channels are coupled, they will share the same x-axis annotation. Only one of the following options can be selected at a time; pressing one of the soft keys automatically de-selects the current mode and selects the new one. The parameters of the source for the selected mode can be set up after returning to the Source Menu.**

CW

Sets the source to the CW mode of operation, in which the frequency and power level can be defined by returning to the Source Menu.

The CW mode assumes that the source is to be used as part of an integrated measurement system (the MTS) where the source and data acquisition system are synchronised. To use the MTS as an independent general purpose microwave source, use the Source Only Mode, accessed from the Source Funcs Menu (page 3-36). In this mode the data acquisition system is turned off, and the instrument acts solely as a microwave source.

Start & Stop Freq Sweep

Sets the source to the swept frequency mode of operation, in which the start and stop values of the frequency sweep and its power level can be defined by returning to the Source Menu.

Cntr & Span Freq Sweep

Similar to the above, but the sweep is defined by the centre frequency and its span.

Power Sweep

Sets the source to the power sweep mode of operation, in which the start and stop values of the power sweep and its frequency can be defined by returning to the Source Menu.

Voltage Sweep

Sets the source to the voltage sweep mode of operation, in which the start and stop values of the voltage sweep can be defined by returning to the Source Menu. The swept voltage is available at the rear panel VOLTAGE/CURRENT OUTPUT connector. A CW RF output is simultaneously available at the RF OUTPUT connector, which can be set up by returning to the Source Menu (*[CW Set-up]* soft key). The voltage sweep mode applies instrument-wide.

Current Sweep

Sets the source to the current sweep mode of operation, in which the start and stop values of the current sweep can be defined by returning to the Source Menu. The swept current is available at the rear panel VOLTAGE/CURRENT OUTPUT connector. A CW RF output is simultaneously available at the RF OUTPUT connector, which can be set up by returning to the Source Menu (*[CW Set-up]* soft key). The current sweep mode applies instrument-wide.

More

This soft key will only displayed if the 6210 Reflection Analyzer is connected, and will only be selectable if the active channel is a reflection analyzer channel. It leads to a sub-menu which provides additional sweep modes for a reflection analyzer channel (see page 3-184).

Return to Source

Returns control to the Source Menu.

Source Funcs

See Fig. 3-11. **This menu enables various source functions to be set up according to the requirements of a particular measurement.**

Levelling & Freq Std

Leads to the Lev & F Std Menu, which enables the levelling mode of the source to be selected, and the frequency standard to be set to internal or external.
See page 3-37.

RF Blanking

This soft key has a toggle action and is used to enable /disable RF blanking. With RF blanking enabled, spurious RF signals are reduced at the RF output by blanking out the signal during the frequency change switching points.

Int/Ext Source

Leads to the Int/Ext Source Menu, which allows either the internal source of the MTS or an external source to be set up.
This soft key is unselectable if the instrument is in source only mode (see below), or if the currently active channel is a fault location channel.
See page 3-38.

Voltage / Current O/P

Leads to the V/I Output Menu, which enables the voltage/current output facility to be set up.
See page 3-39.

CW Filter & Loop BW

Leads to the CW & Loop BW Menu, which enables the CW filter to be switched on or off and the synthesizer loop bandwidth to be varied.
See page 3-41.

Source Only Mode

Toggles the Source Only Mode on or off. In this mode the data acquisition system is turned off and the MTS acts solely as a source, and can be used, for example, as an external source for a second MTS, if desired. When this mode is turned on, a screen is displayed which allows all the parameters of the source to be set up. The Save/Recall and Utility menus are still available but all other menus are locked out and cannot be accessed until source only mode is turned off.
This soft key is unselectable if an external source is being controlled, or if the sweep type is linear list, low pass or waveguide. It is not present if the currently active channel is a fault location channel.

Return to Source

Returns control to the Source Menu.

Lev & F Std

See Fig. 3-11. **This menu is used to select the levelling mode that is used to control the output power, and also allows the operator to select the frequency standard to be used by the synthesized source and frequency counter of the MTS.**

Levelling Levelling is used for power level control, via a fast, closed-loop feedback system. The control (feedback) signal used to level the output can be derived from either the internal levelling detector of the MTS, or from an external detector or power meter, connected to the rear panel EXT LEVEL INPUT.

Internal levelling provides a constant signal at the MTS RF connector regardless of reflections by adjusting the level of the source, thus improving the source match. A further improvement in source match can be gained by using the external levelling mode, so that levelling is done at a point in the system closer to the test port. The emergent signal at the levelled point in the system is constant regardless of the signal travelling back towards the source; in this way the source appears matched.

Frequency Standard Under normal circumstances the internal crystal oscillator of the MTS would be used, but if necessary, an external frequency standard of higher accuracy and stability can be connected to the FREQ STANDARD INPUT/OUTPUT rear connector.

Int Levelling — Sets the levelling mode of the source to internal.

Ext Levelling +ve Det — Sets the levelling mode of the source to external, and requires a detector of positive polarity.

Ext Levelling -ve Det — Sets the levelling mode of the source to external, and requires a detector of negative polarity.

Ext Levelling Power Meter — Sets the levelling mode of the source to external, and requires a power meter levelling output of positive polarity.

Int Std — Selects the internal crystal oscillator of the MTS as the frequency standard. In this mode, the MTS provides a 10 MHz reference output at the FREQ STANDARD INPUT/OUTPUT connector, derived from an internal oscillator.

Ext Std 1 MHz — Enables a 1 MHz external frequency to be used as the frequency standard.

Ext Std 10 MHz — Enables a 10 MHz external frequency to be used as the frequency standard.

Return to Source Func — Returns control to the Source Funcs Menu.

Int/Ext Source

See Fig. 3-11. **Measurements can be performed using either the internal synthesized source of the MTS, or an additional external source (a second MTS) connected to the instrument via the GPIB interface. Both internal and external sources can be controlled from either the front panel or using GPIB commands.**

Int Source Set-up

Allows the parameters of the internal source to be set up, after exiting from this menu.

Ext Source Set-up

Allows the parameters of the external source to be set up, after exiting from this menu. The new parameters will not be transferred until external source control is turned on by using the *[Ext Source Control]* soft key.

Ext Source Control

Toggles external source control on or off. When it is turned off, the external source settings are held within the MTS, but are not sent to the external source. When it is turned on, all settings are transferred to the external source and the external source is kept up to date as changes are made by the user.
This soft key is unselectable if the external source is being set up.

Return to Source Func

Returns control to the Source Funcs Menu.

V/I Output

See Fig. 3-11. **The VOLTAGE/CURRENT OUTPUT connector at the rear panel of the instrument can be programmed to provide a Volts/GHz output when performing swept frequency measurements, a 0-10 V ramp voltage for swept frequency or power measurements, a swept voltage/current output for voltage/current domain measurements, a constant bias voltage/current output, or a chart recorder output. This menu enables the user to set up the scaling of the Volts/GHz output and the value of the constant bias voltage/current. The parameters for the swept voltage/current sweep are set up using the voltage sweep or current sweep menus, accessed via the [SOURCE] key.**

1.0 V/GHz

Sets the voltage/current output to provide an output voltage proportional to the swept frequency, with a scale factor of 1 V/GHz. If the source mode is a power sweep or CW, the output will be set to the appropriate constant value. If the frequency exceeds 20 GHz, the output voltage will clip at 20 V. This parameter applies instrument-wide.

0.5 V/GHz

Sets the voltage/current output to provide an output voltage proportional to the swept frequency, with a scale factor of 0.5 V/GHz. If the source mode is a power sweep or CW, the output will be set to the appropriate constant value. This parameter applies instrument-wide.

Constant Voltage

Sets the voltage/current output to provide a constant voltage, as set by soft key 7; this will be labelled *[Set Voltage]* when constant voltage is selected. This mode applies instrument-wide.

Constant Current

Sets the voltage/current output to provide a constant current, as set by soft key 7; this will be labelled *[Set Current]* when constant current is selected. This mode applies instrument-wide.

10 V Ramp

Sets the voltage/current output to provide a 0-10 V ramp voltage proportional to swept frequency or power. The output will be set to 0 V for CW mode

Chart Recorder

This facility is only available for power readouts. It sets the voltage/current output to provide a voltage proportional to the power level measured by either a power meter sensor connected to Input D, or a scalar detector connected to any input. This output can be used to drive a chart recorder. This mode applies instrument-wide.

If there is more than one readout displayed, the MTS will select the readout that is to be sent to the chart recorder from the following priority list:

Active Channel - Active Readout (highest)
Active Channel - Other Readout
Other Channel - Active Readout
Other Channel - Other Readout (lowest)

The format of the chart recorder output depends on the display format, as set up using the Format Menu ([FORMAT] key).

For Log format (dB/dBm), the chart recorder output scaling is 1 V/decade, i.e.

−7.0 V	−70 dB(m)
−1.0 V	−10 dB(m)
0 V	−0 dB(m)
1 V	+10 dB(m)

For Linear format (Watts), the chart recorder output will be in the range 0 to 5 V, with offset and scaling dependent on the type of sensor:

Type	5 Volts
6910 Series	+20 dBm (100 mW)
6920 Series	−20 dBm (10 µW)
6930 Series	+35 dBm (3.2 W)
6511/6230 Series detectors	+20 dBm (100 mW)

Set Voltage

or

Set Current

This soft key is labelled *[Set Voltage]* or *[Set Current]*, depending on whether the voltage/current output mode is set to constant voltage or constant current. It is used to change the value of constant voltage or current available at the voltage/current output. The available range of values is given in the Performance Data section of Chapter 1. The value specified applies per channel.
This soft key will only be selectable for constant voltage and constant current modes.

Rotary Control √	Step Keys √	Numeric Pad √	Terminator 10−

Return to Source Func

Returns control to the Source Funcs Menu.

CW & Loop BW

See Fig. 3-11. **The CW filter is used to reduce the YIG oscillator tuning bandwidth and lower the residual FM to the values specified in the Performance Data section of Chapter 1. However, this also slows down the response due to the longer settling time. The Loop BW is the bandwidth of the frequency synthesizer phase-locked loop. Low bandwidth reduces the spurious signal content of the RF output but slows down the response; high bandwidth has the opposite effect. The soft keys have the following effect:**

CW Filter Auto — The CW filter is automatically turned ON for CW and power sweep modes, and turned OFF for frequency sweep modes. This is the default mode for the instrument.

CW Filter On — The CW filter is always ON irrespective of the operating mode.

CW Filter Off — The CW filter is always OFF irrespective of the operating mode.

Loop BW Auto — The loop bandwidth is automatically set to LOW for CW and power sweep modes, and HIGH for frequency sweep modes. This is the default mode for the instrument.

Loop BW High — The loop bandwidth is always HIGH irrespective of the operating mode.

Loop BW Low — The loop bandwidth is always LOW irrespective of the operating mode.

Return to Source Func — Returns control to the Source Funcs Menu.

CW Set-up

See Fig: 3-14 **This menu enables the CW frequency and output power of the source to be set up for the voltage and current sweep modes**

Set Output Power

Used to change the output power of the source for the currently active channel. The power range available is given in the Performance Data section of Chapter 1.

Rotary Control √	Step Keys √	Numeric Pad √	Terminator Any

Set Frequency

Used to change the CW frequency of the source for the currently active channel to a value within the range permitted for the particular MTS.

Rotary Control √	Step Keys √	Numeric Pad √	Terminator 10+

Return to Source

Returns control to the Source Menu.

SOURCE

START & STOP
FREQUENCY
SWEEP MODE

Fig. 3-11 SOURCE Menus - Scalar and Readout Channels (Sheet 1)

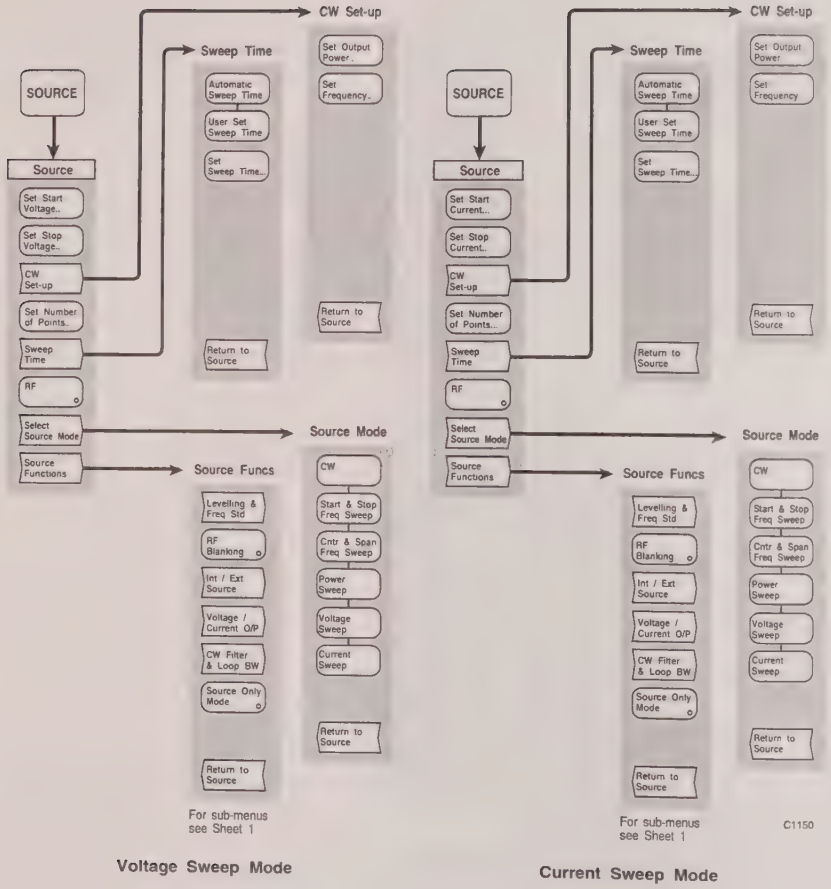


Fig. 3-14 SOURCE Menus - Scalar and Readout Channels (Sheet 4)

SOURCE

CW MODE,

CENTRE & SPAN
FREQUENCY SWEEP MODE

Fig. 3-12 SOURCE Menus - Scalar and Readout Channels (Sheet 2)

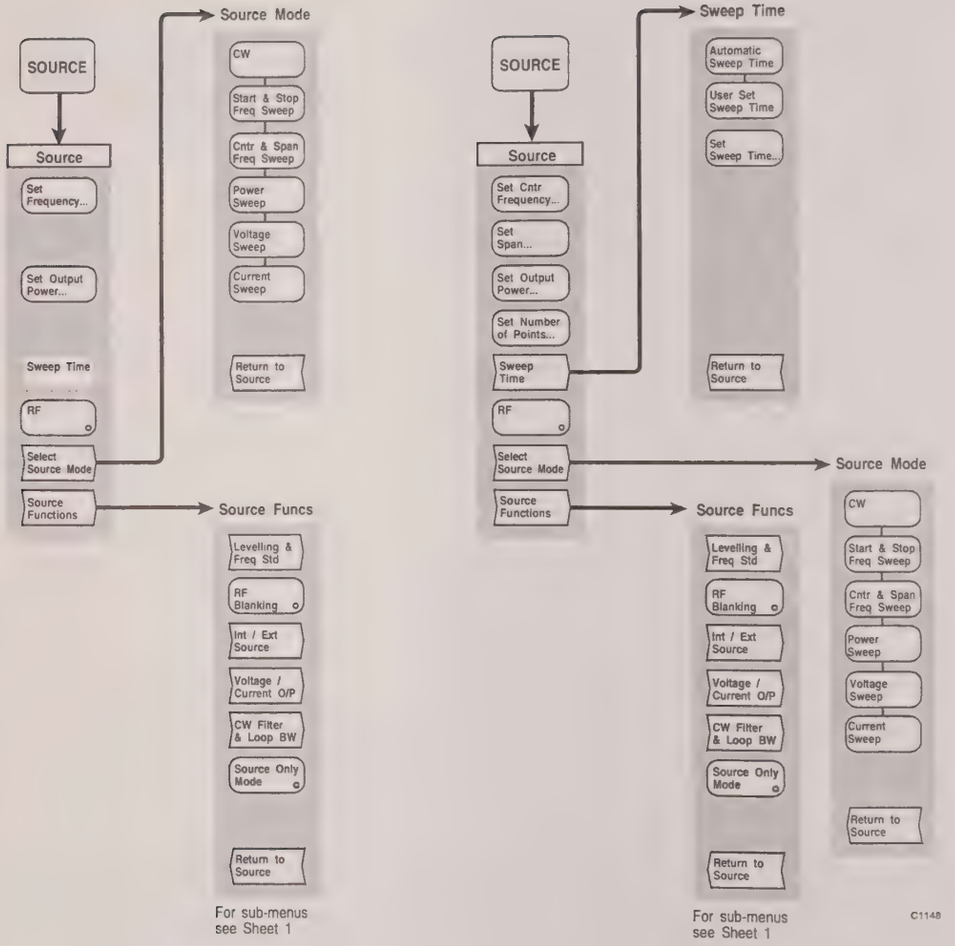
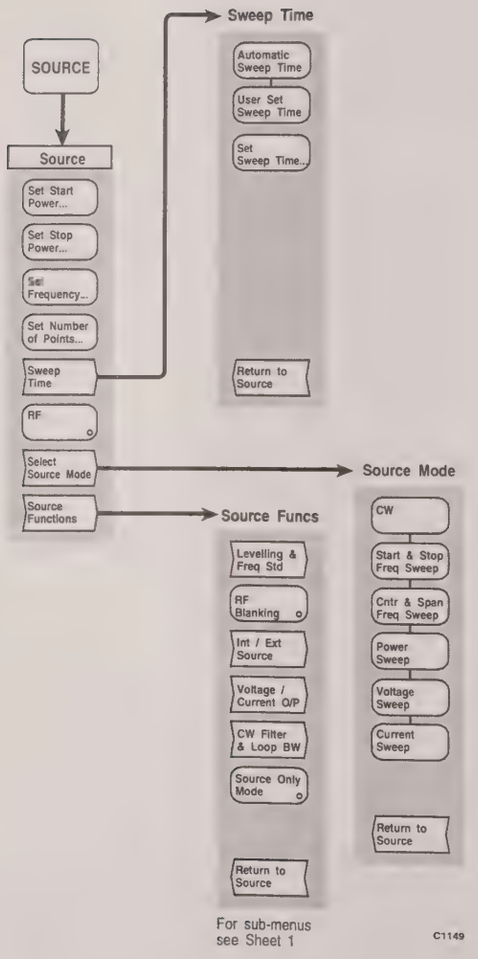


Fig. 3-12 SOURCE Menus - Scalar and Readout Channels (Sheet 2)

SOURCE

POWER SWEEP MODE

Fig. 3-13 SOURCE Menus - Scalar and Readout Channels (Sheet 3)



Power Sweep Mode

Fig. 3-13 SOURCE Menus - Scalar and Readout Channels (Sheet 3)

SOURCE

VOLTAGE SWEEP MODE,
CURRENT SWEEP MODE

Fig. 3-14 SOURCE Menus - Scalar and Readout Channels (Sheet 4)

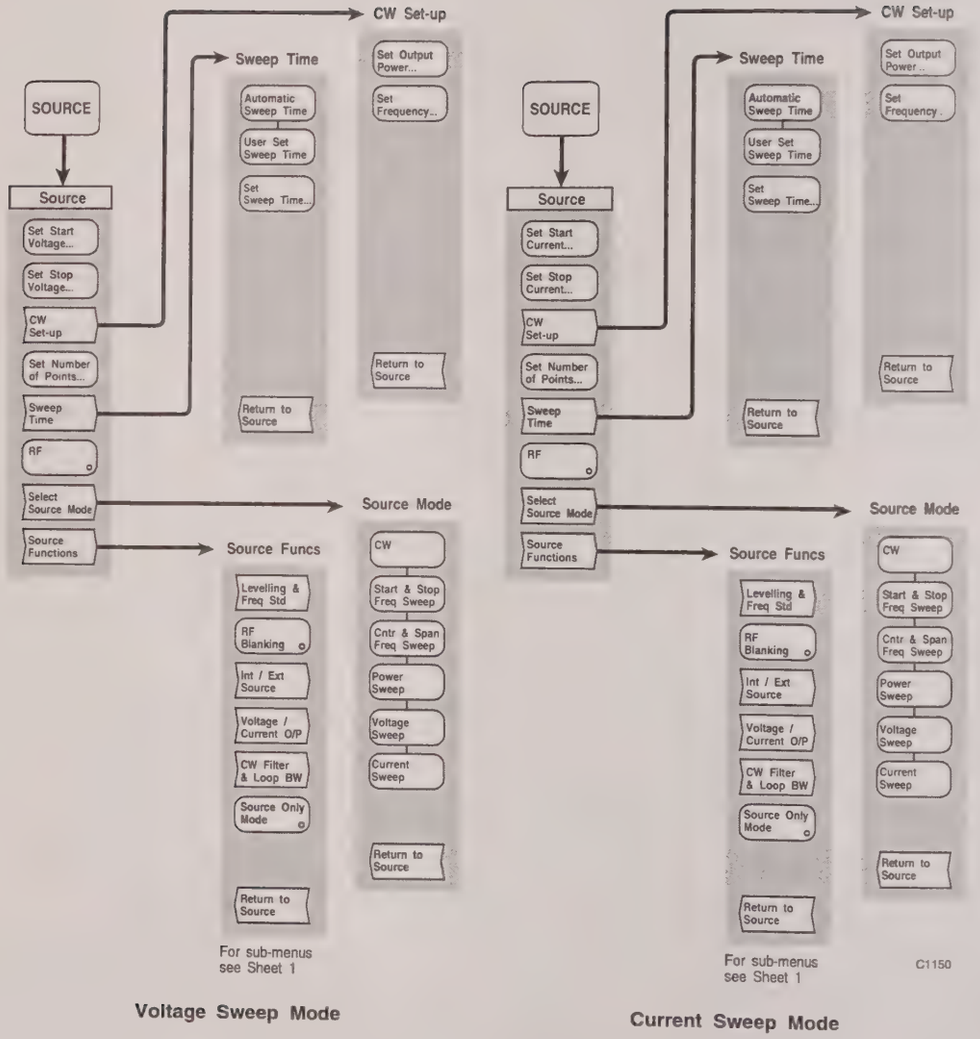


Fig. 3-14 SOURCE Menus - Scalar and Readout Channels (Sheet 4)

[MEASURE] KEY

The [MEASURE] key provides access to the series of menus illustrated in Figs. 3-23 to 3-26. These menus are used to define and set up the scalar measurement and apply various functions to aid examination of the results.

The current values or states for the major measurement functions of the active channel are displayed in specific locations on the screen (see 'Display' earlier in this chapter).

Measure

See Fig. 3-23 **This menu is used to specify whether the system is to measure the absolute power level of a single input or the ratio of two input power levels, and whether path calibration is to be applied. If the source has been set up to provide a voltage or current sweep, the menu will also allow frequency to be measured, which will be displayed on the vertical axis. The user can also apply averaging, smoothing or limit checking to the measurement.**

Single Input A, B, C or D

Leads to the Single Input Menu.
See page 3-53.

Input Ratio

Leads to the Input Ratio Menu.
See page 3-53.

Counter

When this soft key is pressed, the quantity that will be measured and displayed on the vertical axis is the frequency of the signal present at the COUNTER input.
This soft key will only be selectable if the domain for the currently active channel is voltage or current (i.e. the source is set up for either a voltage sweep or a current sweep).

Averaging

Leads to the Averaging Menu, which enables averaging to be applied to the trace data.
See page 3-54.

Restart Averaging

Restarts the averaging process. See also the Averaging Menu (page 3-*54*).

Smoothing

Leads to the Smoothing Menu, which enables smoothing to be applied to the trace data.
See page 3-55.

Limit Checking

Leads to the Lim Checking Menu, which enables the displayed trace to be compared with user-defined limits.
See page 3-56.

General Set-up

Leads to the Gen Set-up Menu, which enables the user to set up the input configuration and to compensate for detector/sensor characteristics.
See page 3-62.

MEASURE — Single Input

Single Input

See Fig. 3-23. **Enables the power level at a selected input to be measured by pressing the appropriate soft key. The power level can be displayed in dBm, Watts or Volts, as selected from the Format Menu ([FORMAT] key).**

It will not be possible to select input D if it is configured to be a power meter sensor input.

A	Selects input A for power measurement.
B	Selects input B for power measurement.
C	Selects input C for power measurement.
D	Selects input D for power measurement.
Return to Measure	Returns control to the Measure Menu.

MEASURE — Input Ratio

Input Ratio

See Fig. 3-24. **Enables the ratio of the power levels at two of the inputs to be measured by selecting the appropriate soft keys. The power ratio can be displayed in dB or VSWR, as selected from the Format Menu.**

It will not be possible to select input D if it is configured to be a power meter sensor input.

A /	Selects input A as the numerator of the desired power ratio measurement. Selecting the numerator leads to a sub-menu where the denominator is chosen (B, C or D).
B /	Selects input B as the numerator of the desired power ratio measurement. Selecting the numerator leads to a sub-menu where the denominator is chosen (A, C or D).
C /	Selects input C as the numerator of the desired power ratio measurement. Selecting the numerator leads to a sub-menu where the denominator is chosen (A, B or D).
D /	Selects input D as the numerator of the desired power ratio measurement. Selecting the numerator leads to a sub-menu where the denominator is chosen (A, B or C).
Return to Measure	Returns control to the Measure Menu.

Averaging

See Fig. 3-23. **This menu enables averaging to be applied to the measurement data, the amount of averaging being set by the user. Averaging is used to reduce the amount of noise on a trace. The minimum amount of averaging should be selected to reduce noise to an acceptable level, in order to maintain a sufficiently fast response.**

Each new sweep is averaged into the trace until the sweep count is equal to the user-entered average number, for a fully averaged trace. This condition is indicated by the 'A' flag in the relevant trace information area. The flag is in lower case until this condition is reached. It is absent if the averaging function is turned off.

The parameters in this menu apply per trace.

Fig. 3-15 illustrates the effect of averaging on a typical measurement trace.

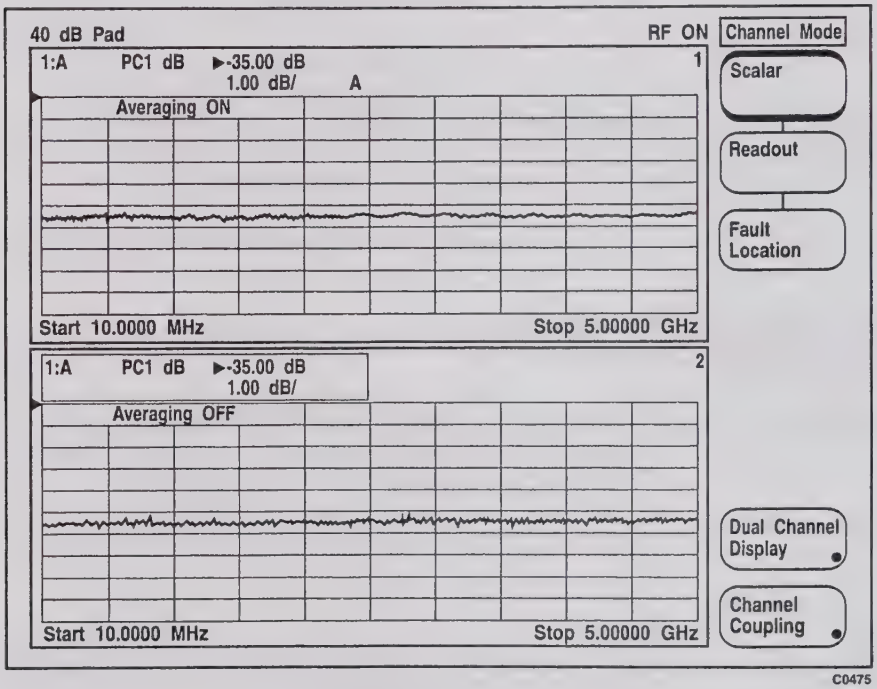


Fig. 3-15 Effect of Averaging on a Trace

Note...

The averaging process can be re-started by using the *[Restart Averaging]* soft key in the Measure Menu.

Averaging

Toggles averaging on or off for the currently active trace.

Set Average Number

Enables selection of the average number to be used in the averaging function. Values in the range 1 to 1000 can be entered. When using the rotary control and step keys the average number will be incremented in powers of 2.

Rotary Control √	Step Keys √	Numeric Pad √	Terminator Any

Return to Measure

Returns control to the Measure Menu.

Smoothing

See Fig. 3-23. **Smoothing is used to filter active trace data by performing a "moving average" on the data over a specified percentage of the sweep span. The parameter that specifies the percentage of the trace to be averaged for each data point is called the smoothing aperture.**

Smoothing should be used to reduce ripple on a trace, e.g. to reduce relatively small peak-to-peak noise values on broadband measured data. Do not use smoothing for measurement of high resonance devices or other devices with wide variations in the trace, as it will introduce errors into the measurement.

Fig. 3-16 illustrates the effect of smoothing on a typical measurement trace.

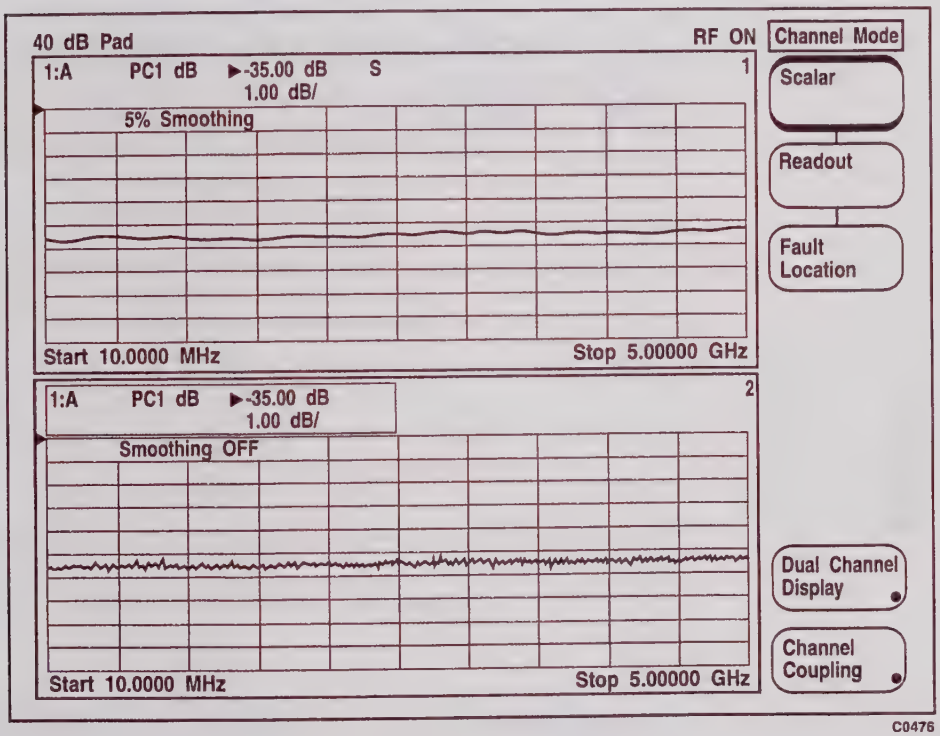


Fig. 3-16 Effect of Smoothing on a Trace

Smoothing Toggles smoothing on or off for the currently active trace. If smoothing is applied to a trace, it is indicated in the relevant trace information area by an 'S' flag.

Set Aperture Enables selection of the smoothing aperture for the currently active trace. The smoothing aperture is a percentage of the span swept, up to a maximum of 20%.

Rotary Control √	Step Keys √	Numeric Pad √	Terminator Any

Return to Measure Returns control to the Measure Menu.

Lim Checking

See Fig. 3-23. **This menu enables a limit checking facility to be implemented, allowing any displayed trace to be compared against upper and lower complex limit lines, defined by the user. Limit lines are lines drawn on the screen to represent upper and lower limits or device specifications with which to compare the device under test. Limits are defined in segments, where each segment is a portion of the source span. Each limit segment can be defined with the following parameters: start domain value, start upper and lower limits, stop domain value, stop upper and lower limits.**

Three types of segments are available: flat line, sloping line and single point. A flat line segment has limit values which are constant with frequency or other domain value. A sloping line segment has limit values which change linearly with the domain value. A single point segment sets the limits at a specified domain value. Fig. 3-17 illustrates limit lines defined for a bandpass filter.

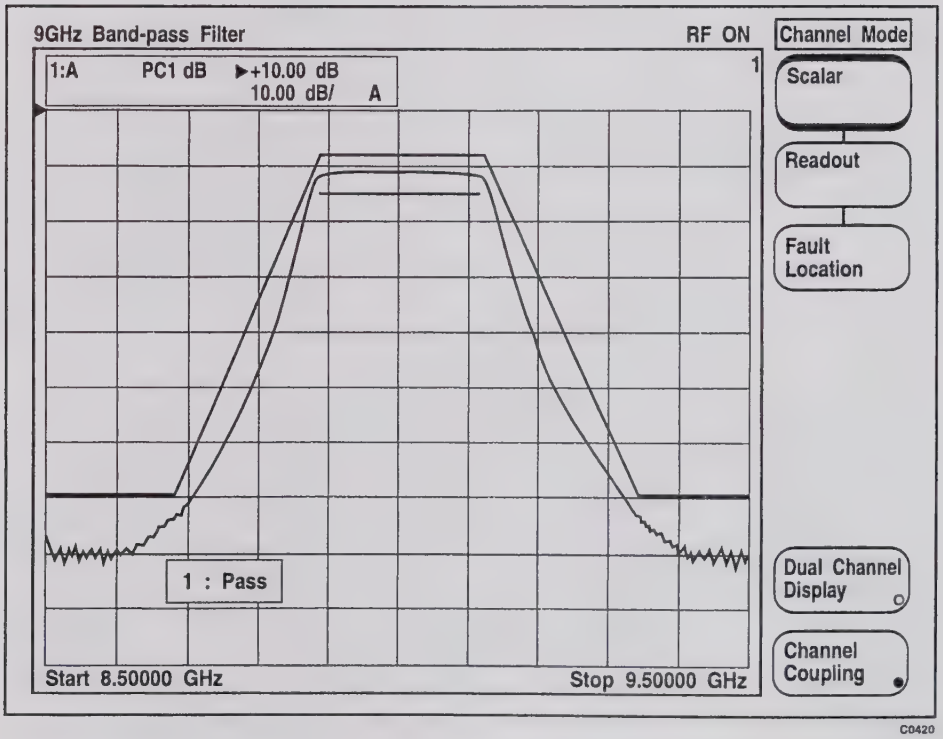


Fig. 3-17 Limit Lines for Bandpass Filter Testing

Limits can be defined independently for all displayed traces, with up to 12 segments for each trace. These can be in any combination of the three segment types.

Limit testing compares the measured data with the defined limits. If all measured data points for a trace are within limits, 1:Pass (for trace 1) or 2:Pass (for trace 2) is displayed on the screen, as appropriate. An out-of-limits test condition is indicated by 1:FAIL (2:FAIL). Limits are checked only at the actual measured data points. It is possible for a device to be out of specification without a limit test failure indication if the point density is insufficient, therefore ensure that a high enough number of measurement points is specified in the Source Menu.

The limit lines are superimposed on the graticule when limit checking is enabled and the corresponding trace is switched on. The limit lines are displayed in colours corresponding to the associated trace colours.

The MTS allows four different limit specifications to be defined by the user. By default, each specification will be associated with a particular trace, but the user can specify one of the other limit specifications to be applied to a trace. A limit specification may be shared by more than one trace.

Limit Checking

Toggles the limit checking facility on or off for the currently active trace.

Edit Specification

Leads to the Edit Spec Menu.
See page 3-58.

Assign Spec 1-4

Used to assign one of the four limit checking specifications to the currently active trace, by entering the desired specification number (1 to 4) from the keyboard.

Rotary Control ×	Step Keys ×	Numeric Pad √	Terminator	Any

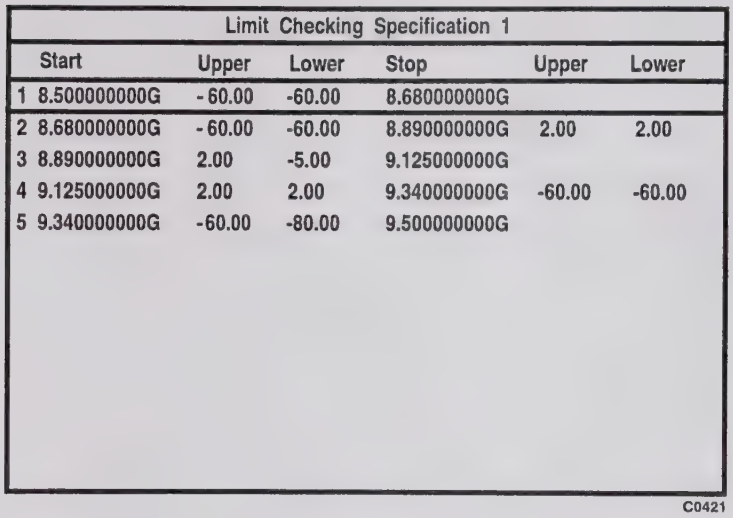
Return to Measure

Returns control to the Measure Menu.

Edit Spec

See Fig. 3-23 This menu is used to set up or edit the current limit checking specification. In addition to soft key labels, a form is displayed on the screen showing the contents of the current limit checking specification, in segment order (Fig. 3-18). Each segment is defined by some or all of the following parameters, depending on the segment type:

Segment number, start domain value, start upper limit, start lower limit, stop domain value, stop upper limit and stop lower limit.



Limit Checking Specification 1						
	Start	Upper	Lower	Stop	Upper	Lower
1	8.500000000G	-60.00	-60.00	8.680000000G		
2	8.680000000G	-60.00	-60.00	8.890000000G	2.00	2.00
3	8.890000000G	2.00	-5.00	9.125000000G		
4	9.125000000G	2.00	2.00	9.340000000G	-60.00	-60.00
5	9.340000000G	-60.00	-80.00	9.500000000G		

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Fig. 3-18 Limit Checking Specification Form

An existing segment is selected for editing using the *[⇑]* and *[⇓]* soft keys and then pressing the *[Edit Segment]* soft key. A new segment can be added by pressing the *[Add Segment]* soft key, or deleted by selecting it using the *[⇑]* and *[⇓]* soft keys and then pressing the *[Delete Segment]* soft key.

Select Spec

Used to select a new limit checking specification for examination or editing, by entering the desired specification number (1 to 4). If the current specification has changed since it was last stored in memory, the user will be given the opportunity to store it before the new specification is presented.

Rotary Control ×	Step Keys ×	Numeric Pad √	Terminator	Any

⇑

Makes the previous segment in the specification the active segment.

⇓

Makes the next segment in the specification the active segment.

Edit Segment

Leads to the Edit Segment Menu.
See page 3-60.

Delete Segment

Deletes the active segment from the specification, after asking for confirmation. The segments below the active one will be moved upwards in the specification form and will be renumbered.

Add Segment

Leads to the Add Segment Menu.
See page 3-61.

Print Spec

Used to obtain a hard copy of the limit checking specification currently being edited.

Unselectable if there are no limit segments displayed.

Return to Lim Checking

The editing function is terminated and control returned to the Lim Checking Menu.

Edit Segment

See Fig. 3-23. **A form is displayed on the screen which enables the user to edit the currently active segment. The *[⇐]* and *[⇒]* soft keys are used to move between the fields of the segments. The currently selected field is changed by entering the required value as follows:**

Start/stop values

Rotary Control	×	Step Keys	×	Numeric Pad	√	Terminator	10+

Upper/lower limit values

Rotary Control	×	Step Keys	×	Numeric Pad	√	Terminator	10−

After the value has been entered, the field to the right of the current one becomes the active field.

Note that a flat line segment does not use the stop upper/lower values, and a single point segment additionally does not use the stop domain value.

If no upper limit is required for a particular measurement, force the upper limit value out of range (for example +200 dB). If no lower limit is required, force the lower limit value out of range (for example -200 dB).

Flat — Defines the selected limit segment as a flat line.

Slope — Defines the selected limit segment as a sloping line.

Point — Defines the selected limit segment as a single point.

⇒ — Makes the next field in the segment the active field.

⇐ — Makes the previous field in the segment the active field.

⇑ — Makes the previous segment in the specification the active segment.

⇓ — Makes the next segment in the specification the active segment.

Return to Edit Spec — Causes the currently active segment to be checked to ensure that the start domain value is lower than the stop domain value, and that each lower limit value is less than its corresponding upper limit value. If the checks fail a message will be displayed; the error must be corrected before the new data will be accepted. If the segment is passed, the segment editing function is terminated and control returns to the Edit Spec Menu.

Add Segment

See Fig. 3-23. **This menu is used to add a new segment to the end of the list, which initially will be of the same type as the previous segment, with all its limit fields set to zero, and its domain values set to the stop domain value of the previous segment. The soft keys are used in the same way as for the Edit Segment Menu (see previous page), but there is now an additional *[Add Segment]* soft key.**

Flat	Defines the selected limit segment as a flat line.
Slope	Defines the selected limit segment as a sloping line.
Point	Defines the selected limit segment as a single point.
⇒	Makes the next field in the segment the active field.
⇐	Makes the previous field in the segment the active field.
Add Segment	Pressing this soft key will cause the segment values to be checked for consistency, as in the Edit Segment Menu. If the checks fail, a message will be displayed and no new segment will be added. If the segment is passed, a new segment will be created at the end of the specification.
Return to Edit Spec	Causes the values of the currently active segment to be checked for consistency, as in the Edit Segment Menu. If the checks fail a message will be displayed; the error must be corrected before the new data will be accepted. If the segment is passed, the segment editing function is terminated and control returns to the Edit Spec Menu.

Gen Set-up

See Fig 3-25. **This menu enables the user to set up the input configuration, apply domain offset/scaling and to compensate for non-ideal characteristics of detectors and sensors. Either AC or DC detection can be selected for scalar measurements.**

Input Configuration

Leads to the Input Config Menu, which is used to set up the input configuration for the measurement.
See page 3-63.

Domain Scale & Offset

Leads to the Scale & Offset Menu, which is used to apply an offset and scale factor for translating between internal frequencies and displayed frequencies. An offset can also be applied to the swept power range.
See page 3-64.

Detector Correction

Leads to the Select Input Menu, which is used to compensate for non-ideal detector characteristics.
See page 3-65.

Sensor Correction

Leads to the Sensor Corr Menu, which is used to apply cal factor and linearity correction for the power sensor connected to the D input.
This soft key will only be selectable if Input D is configured for a power sensor.
See page 3-67

Det / Sensor Specs

Leads to the Edit Specs Menu, which is used to modify detector correction specifications or sensor calibration data tables.
See page 3-69.

AC Detection

Selects AC detection mode for scalar measurements. With AC detection, the RF output to the DUT is chopped, and the resulting pulsed RF output from the DUT is demodulated and processed in such a way that the effects of zero drift are effectively cancelled. The AC mode therefore gives more accurate results for low signal level swept measurements.

The AC detection mode applies instrument-wide.

DC Detection

Selects DC detection mode for scalar measurements. In the DC detection mode, an unmodulated RF signal is used and the detector simply converts the incident RF to an equivalent DC output. This mode will have to be used, for example, when measuring amplifiers with automatic gain control which may behave differently in the presence of amplitude modulated signals. Power meter readings will always use the DC detection mode.

The DC detection mode applies instrument-wide.

Return to Measure

Returns control to the Measure Menu.

Input Config

See Fig 3-25. **This menu provides functions for setting up the configuration of the four inputs.**

An offset to be applied to a corrected detector or power sensor measurement. The offset is effectively a fixed dB value that is added or subtracted from the reading. They are useful for compensating for attenuators or amplifiers between the DUT and detector/power sensor. Use a positive offset value to compensate for attenuation and a negative offset to compensate for gain.

An 'O' flag will be displayed in the trace information area if an offset is being applied to any of the inputs taking part in the measurement.

All Inputs are Scalar

Configures all four inputs A, B, C and D to accept scalar detectors.

Input D is Power Sensor

Configures inputs A, B and C to accept scalar detectors and input D to accept a power meter sensor.

Input A Offset

Enables the offset for Input A to be changed.

Rotary Control	Step Keys	Numeric Pad	Terminator
×	×	√	Any

Input B Offset

Enables the offset for Input B to be changed.

Rotary Control	Step Keys	Numeric Pad	Terminator
×	×	√	Any

Input C Offset

Enables the offset for Input C to be changed.

Rotary Control	Step Keys	Numeric Pad	Terminator
×	×	√	Any

Input D Offset

Enables the offset for Input D to be changed.

Rotary Control	Step Keys	Numeric Pad	Terminator
×	×	√	Any

View Current Configuration

Displays a form on the screen (Fig. 3-19) showing the detector or sensor type connected to each input, and whether manual or automatic correction will be applied (see Select Input Menu, page 3-65). Pressing the *[Return to Input Config]* soft key returns control to the Input Config Menu.

Return to Gen Set-up

Returns control to the Gen Set-up Menu.

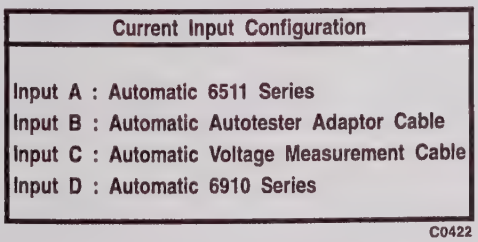
Current Input Configuration
Input A : Automatic 6511 Series
Input B : Automatic Autotester Adaptor Cable
Input C : Automatic Voltage Measurement Cable
Input D : Automatic 6910 Series
C0422

Fig. 3-19 View Input Configuration Screen

Scale & Offset

See Fig 3-25. **This menu enables an offset and scale factor to be entered for translating between displayed frequencies and the frequencies generated by the source at the RF OUTPUT connector. This may be required, for example, if the RF is applied to the DUT via a frequency conversion device. The display can then be set to display the actual frequency applied to the DUT, rather than the source output frequency.**

When outputting frequencies to display, printer/plotter or GPIB:

$$f_{displayed} = (f_{source} \times \text{scale factor}) + f_{offset}$$

When translating to source frequencies from keyboard or GPIB:

$$f_{source} = \frac{f_{displayed} - f_{offset}}{\text{scale factor}}$$

The default values are scale factor = 1, $f_{offset} = 0$.

A power offset can also be applied for translation between the source swept power range and the displayed swept power range, as follows:

When outputting power domain values to display, printer/plotter or GPIB:

$$P_{displayed} = P_{source} + P_{offset}$$

When translating to source power from keyboard or GPIB:

$$P_{source} = P_{displayed} - P_{offset}$$

The default value is $P_{offset} = 0$ dB.

Frequency Offset

Used to change the frequency offset value for the currently active trace. A form is displayed on the screen showing the current offset. This parameter applies per channel. *This soft key will only be selectable if the domain of the currently active channel is the frequency domain.*

Rotary Control	×	Step Keys	×	Numeric Pad	√	Terminator	10+

Frequency Scaling

Used to change the frequency scaling factor for the currently active trace. A form is displayed on the screen showing the current scaling factor. This parameter applies per channel.
This soft key will only be selectable if the domain of the currently active channel is the frequency domain.

Rotary Control	×	Step Keys	×	Numeric Pad	√	Terminator	Any

Power Offset

Used to change the power offset value for the currently active trace. A form is displayed on the screen showing the current offset. This parameter applies per channel.
This soft key will only be selectable if the domain of the currently active channel is the power domain.

Rotary Control ×	Step Keys ×	Numeric Pad √	Terminator 10–

Return to Gen Set-up

Returns control to the Gen Set-up Menu.

MEASURE → **General Set-up** → **Detector Correction**

Select Input

See Fig 3-25. **Below a certain power level, detectors are assumed to obey a square law response, where the detector output voltage is directly proportional to the input power. Above that level, deviation from the square law results in power readings lower than expected, which are corrected for by using a table of correction specifications. This table, held in non-volatile memory, contains an entry for all the detector types supported by the MTS. A detector type is characterised by a sensitivity factor (in mV/mW) and a power factor.**

The instrument permits either manual or automatic selection of a correction specification. For manual selection, the user enters the required specification number. When automatic selection is enabled, the instrument determines the required specification from a self-identification mechanism built into the detector. For detectors without the self-identification facility, automatic selection defaults to the correction table for 6511 detectors, and a warning message is displayed. Correction can be turned off, if required, e.g. when measuring voltage.

The soft keys in this menu are used to select the detector input to which correction is to be applied, and leads to a sub-menu.

Input A

Leads to the Input A Menu.

Input B

Leads to the Input B Menu.

Input C

Leads to the Input C Menu.

Input D

Leads to the Input D Menu.

Return to Gen Set-up

Returns control to the Gen Set-up Menu.

Input A (B, C or D) *See Fig 3-25.* **These four menus are identical, and are used to specify the type of correction and the detector type for the input.**

Correction Auto Sense Sets the detector correction mode for the selected input to automatic.

Correction User Set Enables manual entry of the detector type, by using the *[Set Detector Type]* soft key.

Correction Off Turns off detector correction.

Set Detector Type Selects the type of detector that is to be corrected. When this soft key is pressed, a table is displayed listing all the possible detector types and their identity numbers (Fig. 3-20).

Four entries in the table are reserved for user-specified values of sensitivity factor and power factor. These values can be set using the Edit Specs Menu (page 3-69).
This soft key is only selectable if manual entry of the detector type has been selected ([Correction User Set] soft key).

Rotary Control ×	Step Keys ×	Numeric Pad √	Terminator Any

Set Detector Type			
1	:6511	9	:Reserved
2	:6512	10	:Reserved
3	:6513	11	:Reserved
4	:6514	12	:USER1
5	:6230	13	:USER2
6	:6233	14	:USER3
7	:6234	15	:USER4
8	:Reserved		
Detector Number :1			

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Fig. 3-20 Detector Types Table

Temperature Correction This soft key has a toggle action and is used to enable/disable scalar detector temperature correction. When enabled, temperature correction will apply to detectors for which temperature correction is available (e.g. the 6230 series). This function applies per input.

Return to Select Input Returns control to the Select Input Menu.

Sensor Corr

See Fig. 3-25. **Calibration data for all sensors used with the MTS are stored in non-volatile memory. The power sensors have a self-identification mechanism built in to enable the instrument to determine the sensor type. The calibration data comprises a 50 MHz cal factor, a linearity factor and a cal factor table. Each entry in the cal factor table consists of a frequency and a corresponding cal factor, stored in ascending order of frequency.**

The cal factor can either be entered manually or derived from a cal factor table. In order that a cal factor can be applied using a cal factor table, it is necessary to know the frequency at which the power measurement is being made. The following options are provided:

Manual entry of frequency
Frequency read from the counter
Frequency defined by the source

If a counter is used to define the frequency, at least one readout must be configured for frequency measurement. A counter reading will be taken and stored once per measurement update. If a reading cannot be obtained for any reason, the most recent counter reading or manually entered frequency will be used.

If the source is used to define the frequency, channel coupling must be on. The frequency used will depend on the source mode. If the source mode is CW or a power sweep, the CW frequency will be used. If the source mode is a swept frequency, the position of the active marker is used to define the frequency.

The frequency as defined above will be used to extract a value of cal factor from the table using linear interpolation. If the frequency lies outside the range for which data is available, the cal factor corresponding to the frequency nearest to the required frequency will be used, and the user will be informed via the display.

The cal factor will be applied as follows:

$$\text{Corrected Power} = \frac{\text{Measured Power} \times 100}{\text{Cal Factor (\%)}}$$

Cal Factor User Set

Enables manual entry of the cal factor by using the *[Cal Factor & Lin Factor]* soft key.

Cal Factor User Freq

Enables manual entry of the cal factor frequency by using the *[Set Frequency]* soft key.

Cal Factor Counter Freq

Applies a cal factor which corresponds to the frequency measured by the counter. *This soft key is only selectable if at least one of the other measurements is a counter measurement.*

Cal Factor Source Freq

Applies a cal factor which corresponds to the frequency of the source.

Cal Factor & Lin Factor

Leads to the Cal & Lin Fact Menu, which allows cal factor and linearity factor for a sensor to be specified.
This soft key is only selectable if manual entry of the cal factor has been selected using the [Cal Factor User Set] soft key)
See below

Set Frequency

Used to change the frequency value that is used to obtain the cal factor for input D.
This soft key is only selectable if manual entry of the cal factor frequency has been selected by using the [Cal Factor User Freq] soft key.

Rotary Control √	Step Keys √	Numeric Pad √	Terminator 10+

Select Cal Fact Table

Used to select the cal factor table that the cal factor for input D will be selected from. A form is displayed listing the available cal factor tables, and the current cal factor table identity number.
This soft key is unselectable if manual entry of the cal factor has been selected.

Rotary Control ×	Step Keys ×	Numeric Pad √	Terminator Any

Return to Gen Set-up

Returns control to the Gen Set-up Menu.

MEASURE → **General Set-up** → **Sensor Correction** → **Cal Factor & Lin Factor**

Cal & Lin Fact

See Fig. 3-25. **This menu enables manual entry of cal factor and linearity factor for a power sensor connected to input D.**

Set Cal Factor

Used to change the cal factor for the sensor.

Rotary Control √	Step Keys √	Numeric Pad √	Terminator Any

Set Lin Factor

Used to change the linearity factor for the sensor.

Rotary Control √	Step Keys √	Numeric Pad √	Terminator Any

Return to Sensor Corr

Returns control to the Sensor Corr Menu.

MEASURE → General Set-up → Det / Sensor Specs

Edit Specs

See Fig 3-25. **This menu is used to edit the sensitivity and power factor values of the four user-defined detector correction specifications, and to edit the power sensor calibration data tables.**

Edit Det Corr Spec

Leads to the Edit Det Specs Menu, which enables editing of correction data for the user-defined detectors.
See page 3-69

Edit Sensor Cal Data

Leads the Edit Spec Menu, which is used for editing the calibration data for the current sensor.
See page 3-70.

Return to Gen Set-up

Returns control to the Gen Set-up Menu.

MEASURE → General Set-up → Det / Sensor Specs → Edit Det Corr Spec

or

UTILITY → Service → Det / Sensor Specs → Edit Det Corr Spec

Edit Det Specs

See Fig 3-25. **This menu is used to edit the sensitivity and power factor values of the four user-defined detector correction specifications. A form is displayed on the screen showing the sensitivity and power factor values for the detectors. The soft keys enable selection of the value that is to be changed. The new value is entered as follows:**

Rotary Control	×	Step Keys	×	Numeric Pad	√	Terminator	Any

⇐ Selects the active field for numeric entry.

⇒ Selects the active field for numeric entry.

⇑ Selects the previous user-defined detector.

⇓ Selects the next user-defined detector.

Edit Identity

Leads to a sub-menu and displays a form which enables an identity of up to ten characters to be entered. The method of entry is the same as that described for the Screen Title Menu (page 3-276).

Return to Edit Specs

Terminates the editing function and writes the new data into the non-volatile memory which holds the correction specification. Control is then returned to the Edit Specs Menu.

Detector Correction Specifications		
Identity	Sensitivity	Power Factor
USER1	349.1200 mV/mW	800.0m
USER2	393.9600 mV/mW	1.00
USER3	0.00000 V/mW	1.00
USER4	0.00000 V/mW	1.00

C0424

Fig. 3-21 User Detector Correction Specification Form

MEASURE | General Set-up | Det / Sensor Specs | Edit Sensor Cal Data

or

UTILITY | Service | Det / Sensor Specs | Edit Sensor Cal Data

Edit Spec

See Fig. 3-26. **This menu and the associated sub-menus are used to edit the power sensor calibration data tables. A form is displayed on the screen (Fig. 3-22) showing the calibration data table contents for the current sensor.**

See the Sensor Correction Menu description (page 3-67) for an explanation of how the calibration data is used for power sensor correction.

Power Sensor Cal Data 1	
Table Identity : 6910 Serial No. 138	
50 MHz Cal Factor : 100.00% Linearity Factor : 9.50	
Frequency	Cal Factor
10.00000 MHz	99.04%
30.00000 MHz	100.00%
50.00000 MHz	100.00%
100.00000 MHz	99.37%
300.00000 MHz	100.00%
500.00000 MHz	99.99%
1.00000 GHz	99.63%
2.00000 GHz	98.48%
3.00000 GHz	98.04%
4.00000 GHz	97.68%
5.00000 GHz	96.83%

C0425

Fig. 3-22 Sensor Cal Data Table

Select Table

Used to select a new cal factor table that the cal factor for input D will be selected from. A form is displayed listing the sensor identities. If the current table has changed since it was last saved, the user will be given the opportunity to save it before the new table is presented.

Rotary Control ×	Step Keys ×	Numeric Pad √	Terminator	Any

Set Table Identity

Enables the entry of a text string as the identity of the table. The method of entry is the same as that described for the Screen Title Menu (page 3-276).

50 MHz Cal Factor

Used to change the 50 MHz cal factor for the sensor.

Rotary Control ×	Step Keys ×	Numeric Pad √	Terminator	Any

Linearity Factor

Used to change the linearity factor for the sensor.

Rotary Control ×	Step Keys ×	Numeric Pad √	Terminator	Any

Edit Table — Leads to the Edit Table Menu, which provides facilities for editing the frequency and cal factor values in the table of entries.
See below:

Save Table — Causes the current cal data table to be saved in non-volatile memory.

Return to Edit Specs — Initially checks whether the current cal data table has changed since it was last saved. If it has, a prompt will be displayed asking if the table is to be saved. The editing function will then be terminated and control returned to the Edit Specs Menu.

MEASURE → General Set-up → Det / Sensor Specs → Edit Sensor Cal Data → Edit Table

or

UTILITY → Service → Det / Sensor Specs → Edit Sensor Cal Data → Edit Table

Edit Table — *See Fig. 3-26.* **This menu provides facilities for editing entries in the cal data table, and adding or deleting entries.**

Edit Entry — Leads to the Edit Entry Menu.

Add Entry — Leads to the Add Entry Menu.

Delete Entry — Deletes the active entry from the specification after prompting for confirmations. The entries below the active one will be moved upwards and renumbered.

⇑ — Makes the previous entry in the table the active entry.

⇓ — Makes the next entry in the table the active entry.

Page Up — The previous page of entries in the table will be displayed.

Page Down — The next page of entries in the table will be displayed.

Return to Edit Spec — Returns control to the Edit Spec Menu.

Edit Entry

See Fig. 3-26. **This menu allows an entry in the cal data table to be edited. The new cal factor is changed as follows:**

Rotary Control ×	Step Keys ×	Numeric Pad √	Terminator Any

Note that this menu only allows cal factor values to be edited. If a frequency is to be changed, the *[Add Entry]* soft key of the Edit Table Menu must be used to add a new entry with the required frequency, and the *[Delete Entry]* soft key used to remove the unwanted entry.

⇑ Makes the previous entry in the table the active entry.

⇓ Makes the next entry in the table the active entry.

Page Up The previous page of entries in the table will be displayed.

Page Down The next page of entries in the table will be displayed.

Return to Edit Table Returns the user to the Edit Table Menu.

MEASURE	General Set-up	Det / Sensor Specs	Edit Sensor Cal Data	Edit Table	Add Entry
or					
UTILITY	Service	Det / Sensor Specs	Edit Sensor Cal Data	Edit Table	Add Entry

Add Entry

See Fig. 3-26. **Enables a new entry to be added to the cal factor table. Initially, the frequency and cal factor fields contain the default values of 50 MHz and 100% respectively. Entry of cal factor values is he same as for the Edit Entry screen. Frequency values are entered as follows:**

Rotary Control ×	Step Keys ×	Numeric Pad √	Terminator 10+

⇒ Selects the active field for numeric entry.

⇐ Selects the active field for numeric entry.

Add Entry Inserts the entry into the appropriate place in the table (an existing entry that has the same frequency will be overwritten). The fields will then be set to their default values.

Return to Edit Table Terminates the add entry function and returns the user to the Edit Table Menu, after performing a check as above.

Fig. 3-23 SOURCE Menus - Scalar and Readout Channels (Sheet 1)

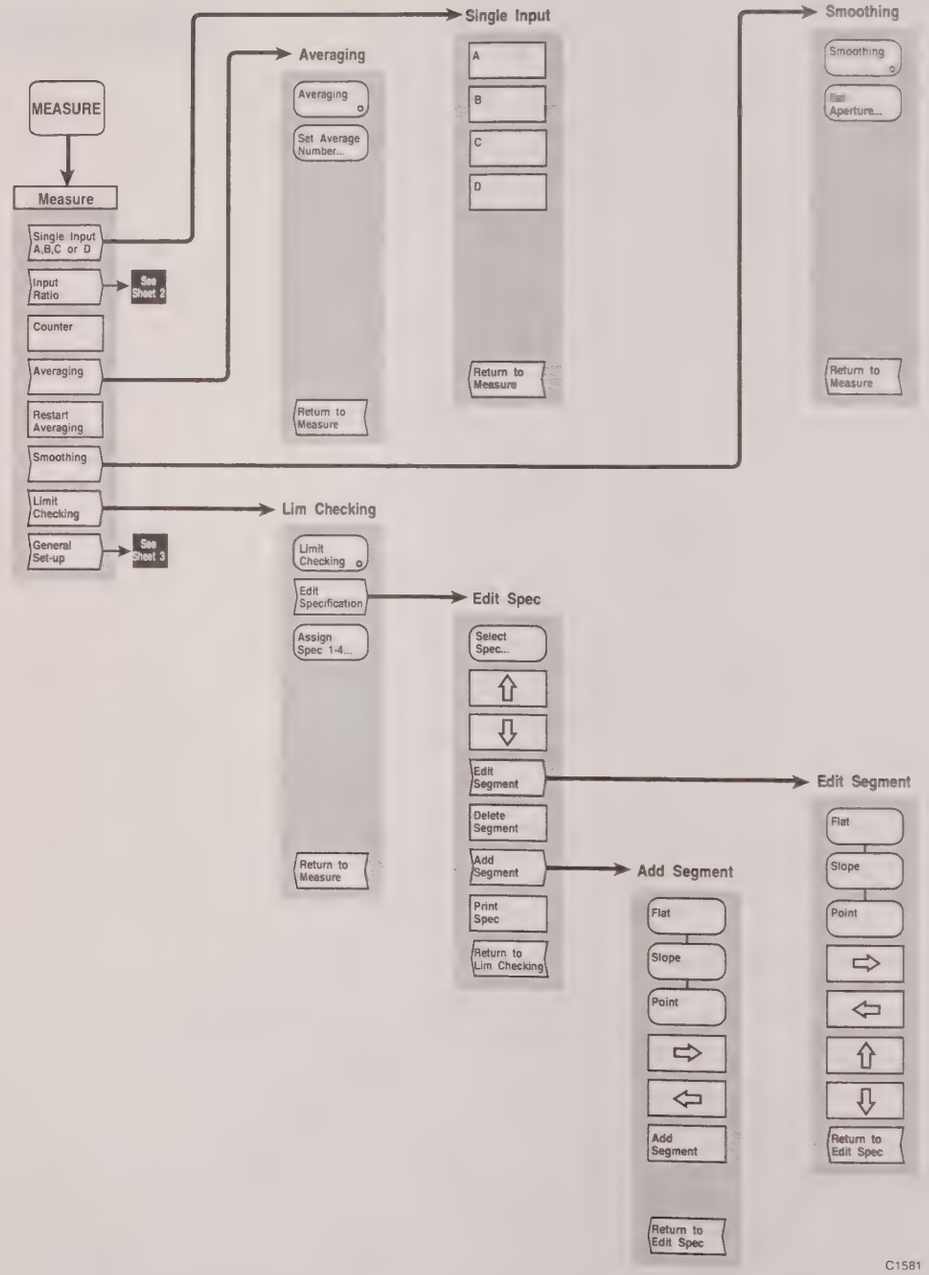

Fig. 3-23 MEASURE Menus - Scalar Channel (Sheet 1)

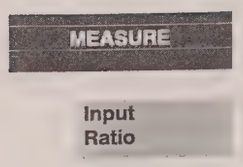

Fig. 3-24 MEASURE Menus - Scalar Channel (Sheet 2)

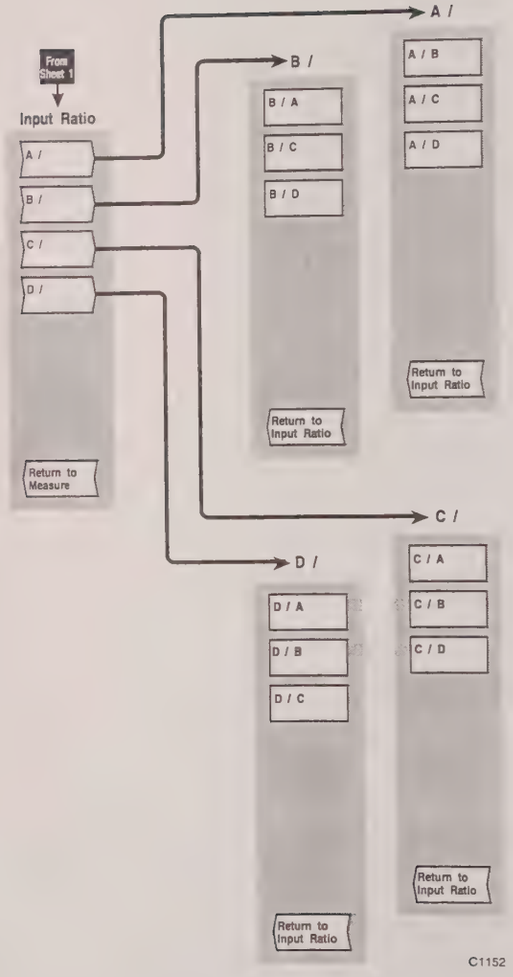

Fig. 3-24 MEASURE Menus - Scalar Channel (Sheet 2)

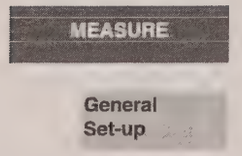

Fig. 3-25 MEASURE Menus - Scalar Channel (Sheet 3)

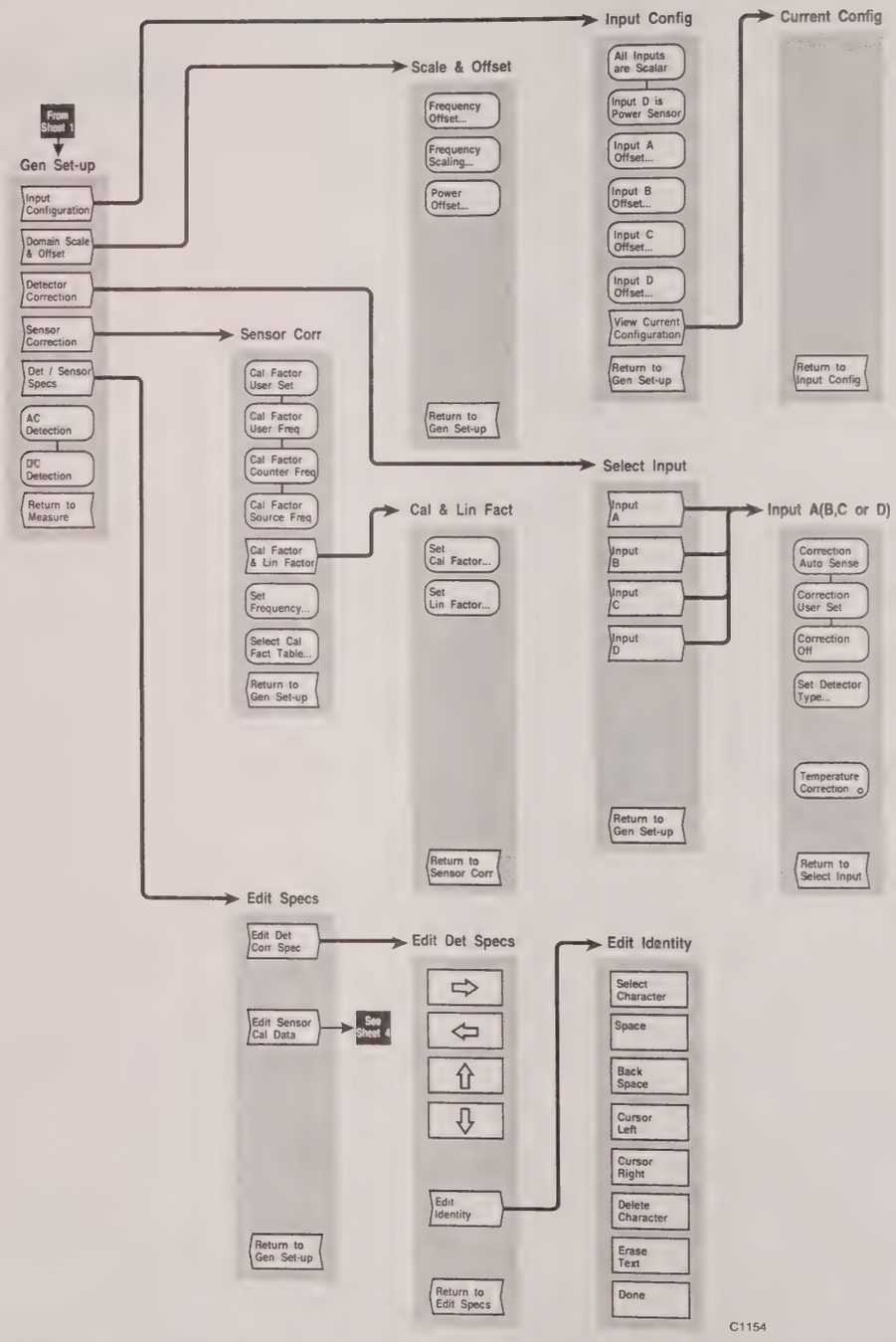

Fig. 3-25 MEASURE Menus - Scalar Channel (Sheet 3)

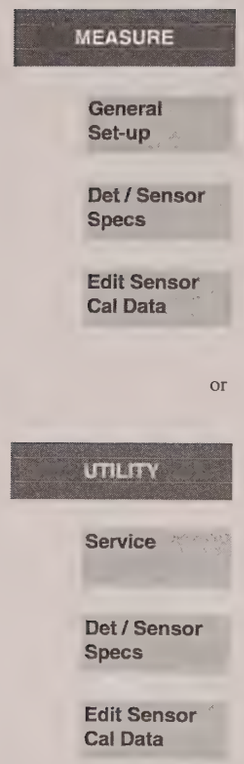

Fig. 3-26 MEASURE Menus - Scalar Channel (Sheet 4)

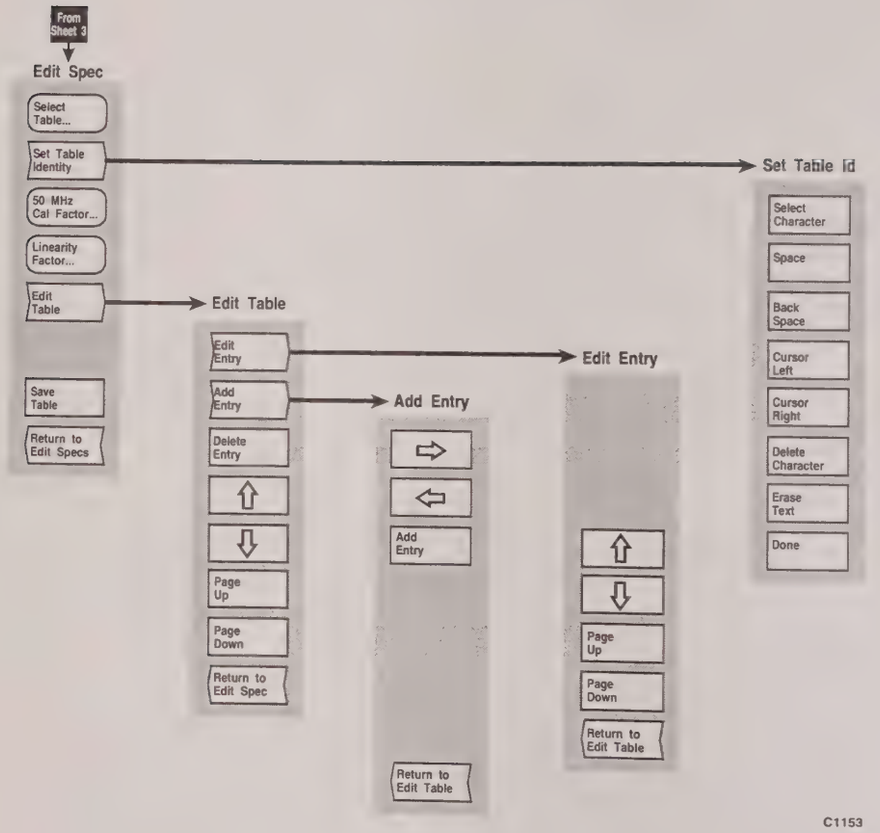

Fig. 3-26 MEASURE Menus - Scalar Channel (Sheet 4)

[CAL] KEY

The [CAL] key provides access to the calibration menu (Fig. 3-27). Calibration is used prior to a measurement in order to remove system errors that cause uncertainty in measuring a device under test.

Frequency variations in the components that comprise the measurement system (connectors, adapters, cables etc.) can be taken into account when making a component measurement. The MTS analyzes and stores the variations and automatically removes them from the measurement. This is known as path calibration since it calibrates out the frequency variations in each measurement path.

One of four stored path calibrations can be applied to the current measurement, which have previously been set up using the appropriate soft keys. The current measurement data is ratioed with the path calibration data before being formatted and displayed. The trace information area of the display indicates if path calibration is being applied to a trace, and the identity of the path calibration store. By default, each path calibration store is associated with a particular trace. However, it is possible for a trace to use one of the other path calibration stores, so that a single path cal can be shared by more than one trace.

If the calibration becomes invalid (e.g. due to subsequent changes in the source set-up) a warning message will be displayed and a "?" is displayed after the calibration identity.

Path calibration facilities are not available when making frequency measurements under swept conditions.

Power sensor calibration utilises the 50 MHz, 1 mW power reference output available from the front panel. A sensor is calibrated by connecting it to the power reference output (via a 30 dB attenuator for 6920 series sensors) and pressing the *[Sensor Cal]* soft key. The system measures the difference between the sensor and reference outputs and uses this to correct subsequent measurements. The power reference will be switched on and off automatically as required by the calibration process.

Cal

See Fig. 3-27. **This menu provides facilities for calibrating the measurement system for a scalar channel, and applying any of four stored path calibrations to a measurement. It also provides access to menus for detector/sensor zeroing and sensor calibration.**

Through Path Cal

Leads to the Through PC Menu, which is used to carry out a through path calibration on the currently active scalar channel.
See page 3-85.

Short / Open Path Cal

Leads to the Short/Open PC Menu, which is used to carry out a short/open path calibration on the currently active scalar channel.
See page 3-86.

Short Path Cal

Leads to the Short PC Menu, which is used to carry out a path calibration on the currently active scalar channel by using a short circuit termination.
See page 3-86.

Apply Path Cal 1-4

Enables one of four path calibrations to be used in the measurement by entering the required identity number. The relevant trace information area will indicate if path calibration is being applied to a trace, and also the path cal store that is being used (see page 3-16.

Rotary Control ×	Step Keys ×	Numeric Pad √	Terminator None

Path Cal Off

Turns off path calibration if it is not required.

Det / Sensor Zero

Leads to the Det/Sen Zero Menu, which is used for zeroing detectors/sensors.
See page 3-87.

Sensor Cal

Leads to the Sensor Cal Menu, which is used to zero the power sensor and to calibrate it against the reference.
This soft key will only be selectable if Input D is configured for a power sensor.
See page 3-88.

Power Ref

Toggles the power reference output on and off. The reference can be used, for example, to verify that the power sensor is functioning correctly. The Power Reference On indicator (PWRREF) will be present in the General Information Area at the top of the screen if a power reference signal is being output.

Through PC

See Fig. 3-27. **This menu is used to carry out a through path calibration on the currently active scalar channel. It compensates for residual levelling errors in the source and frequency variations in the components that form the measuring system.**

The user is prompted to make the through connection. The *[Select Path Cal Store]* soft key is used to specify the path calibration store that is to be used for storing the calibration data. The *[Continue]* soft key starts the calibration process. The user is informed when calibration data has been acquired and path calibration has been applied. The function then terminates and the user is returned to the initial Cal Menu.

Continue

Starts the calibration process.

Select Path Cal Store

Used to specify the path calibration store that is to be used for storing the calibration data by entering a number in the range 1 to 4.

Rotary Control	Step Keys	Numeric Pad	Terminator	
×	×	√	Any	

Abort Calibration

Terminates the calibration process. The current path cal store will not be affected.

CAL

Short / Open Path Cal

Short/Open PC

See Fig. 3-27. **This menu is used to carry out a short/open path calibration on the currently active scalar channel. It calibrates the system against a known reference when measuring return loss. Open circuit and short circuit terminations are chosen as both of these devices theoretically reflect 100% of the power incident upon them and therefore have a return loss of 0 dB. If only an open or short circuit is used for calibration, however, there is an uncertainty added to the measurements due to test port impedance mismatch. This uncertainty is minimized by calibrating the system against both open and short circuits and calculating the average path cal.**

The user is prompted to connect the short. The *[Select Path Cal Store]* soft key is used to specify the path calibration store that is to be used for storing the calibration data. The *[Continue]* soft key starts the calibration process. When the short calibration data has been acquired, the user is prompted to connect the open termination and press *[Continue]* when ready. The user is informed when the open calibration data has been acquired and path calibration has been applied. The calibration data is stored in the specified path cal store. The function then terminates and the user is returned to the initial Cal Menu.

Continue

Starts the calibration process.

Select Path Cal Store

Used to specify the path calibration store that is to be used for storing the calibration data by entering a number in the range 1 to 4.

Rotary Control ×	Step Keys ×	Numeric Pad √	Terminator	Any

Abort Calibration

Used to terminate the calibration process at any time. The current path cal store will not be affected.

CAL

Short Path Cal

Short PC

See Fig. 3-27. **This menu functions in a similar way to the Short/Open PC Menu, except that a path cal is performed using only a short circuit termination. This method would be used, for example, in waveguide measurements, since a practical open circuit is not achievable for waveguide systems.**

Continue

Starts the calibration process.

Select Path Cal Store

Used to specify the path calibration store that is to be used for storing the calibration data by entering a number in the range 1 to 4.

Rotary Control ×	Step Keys ×	Numeric Pad √	Terminator	Any

Abort Calibration

Used to terminate the calibration process at any time. The current path cal store will not be affected.

Det/Sen Zero

This menu enables detector zeroing to be performed for all scalar detectors connected to the instrument. Zeroing is used to remove the effects of zero drift from the measurement. It is especially important for low level measurements (<–40 dBm). At very low levels (<–60 dBm), zeroing should be done every few minutes, but preferably using the autozeroing facility. The menu also enables power sensor zeroing to be performed.

Detector Autozeroing

Toggles the autozeroing facility on or off. When enabled, the detectors will be zeroed automatically once every measurement update. The MTS momentarily turns off the RF in order to do this. The setting of this parameter applies instrument-wide. The **AZ** indicator is displayed in the General Information Area when autozeroing is on.

The autozero facility only operates if a manual zero has previously been performed (see *[Zero Detectors)]*.

Zero Detectors

Initiates zeroing of the detectors. A zero will be performed on all inputs, including any that do not have a detector connected. If a detector is then connected to one of these previously unused inputs, the zero is no longer valid and misleading results could occur. It is therefore necessary to perform a detector zero each time a detector is connected to an input.

The source power will be automatically turned off during a detector zero. If a source other than the MTS is providing the RF signal, it must be turned off before performing a zero.

Zero Sensor D

Initiates zeroing of a power sensor connected to input D. The zero facility must only be used with no incident RF at the sensor. A horizontal bar indicator shows the percentage of the zeroing operation that has been completed.
This function is only selectable if input D has been configured to accept a power sensor. .

Return to Cal

Returns control to the Cal Menu.

CAL → Sensor Cal

or

UTILITY → Service → Instrument Calibrations → Source Power Cal → Broadband Power Cal → Sensor Cal

or

UTILITY → Service → Instrument Calibrations → Source Power Cal → Narrowband Power Cal → Sensor Cal

Sensor Cal

This menu is used to zero the power sensor and to calibrate it against the reference. The user is prompted to connect the power sensor to the reference output and press the *[Continue]* soft key when ready. The MTS turns off the power reference and a horizontal bar is displayed informing the user of the progress of the zeroing, as a percentage of the time to completion. The power reference is then turned on and the MTS performs sensor calibrations; a similar percentage indicator is displayed. When calibration has been completed the function terminates and the user is returned to the initial Cal menu.

Note...

If an external power reference is used to calibrate the sensor, ensure that no power is present during the zeroing phase. When zeroing has completed, the MTS allows a period of 5s for the user to turn on the power reference for the calibration phase.

Continue

Starts sensor calibration.

Select Table

Used to select the cal factor table appropriate to the power sensor being used, by entering the cal factor table identity number.
This soft key is unselectable if manual entry of the cal factor has been selected (see Sensor Correction Menu - [MEASURE][General Set-up][Sensor Correction]).

Rotary Control	×	Step Keys	×	Numeric Pad	√	Terminator	Any

Set Cal Factor

Used to change the cal factor for the sensor.
This soft key is only selectable if manual entry of the cal factor has been selected ([MEASURE][General Set-up][Sensor Correction][Cal Factor User Set]).

Rotary Control	√	Step Keys	√	Numeric Pad	√	Terminator	Any

Set Lin Factor

Used to change the linearity factor for the sensor.
This soft key is only selectable if manual entry of the cal factor has been selected ([MEASURE][General Set-up][Sensor Correction][Cal Factor User Set]).

Rotary Control	√	Step Keys	√	Numeric Pad	√	Terminator	Any

Abort Calibration

Terminates the calibration process.

Fig. 3-27 CAL Menu - Scalar Channel

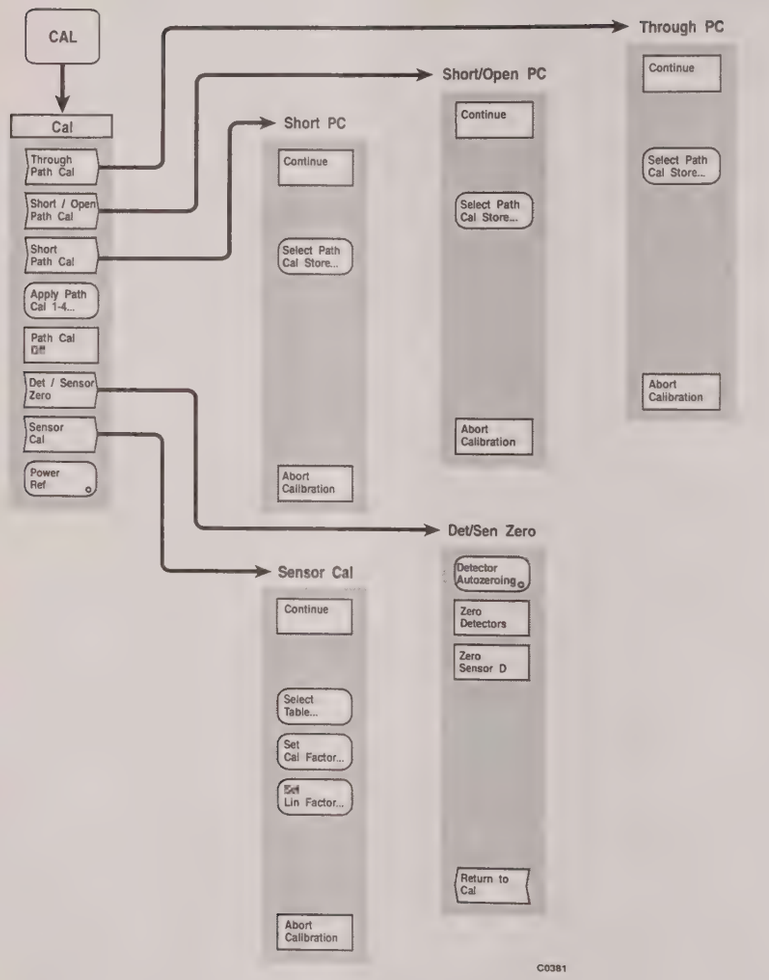

Fig. 3-27 CAL Menu - Scalar Channel

[FORMAT] KEY

The [FORMAT] key enables the active measurement in the active channel to be displayed in the required format; i.e. the units in which the response (vertical axis) is scaled. The options available depend upon the input configuration.

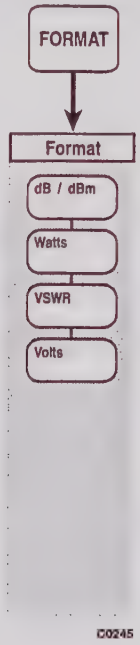

Fig. 3-28 FORMAT Menu - Scalar Channel

FORMAT

Format **The soft keys in this menu enable the following display formats to be selected:**

Linear: Watts, VSWR, Volts
Log: dB/dBm

The display format can be set up independently for each trace of the active channel. The formats permitted depends upon the measurement

dB / dBm Selects dB/dBm format. The instrument will automatically select dB or dBm depending on whether the measurement is a ratio of inputs (i.e. relative power measurement) or a single input (i.e. absolute power measurement). The dB format is also selected if path calibration is applied or if the measurement is made relative to a memory.
This soft key will only be selectable for absolute or relative power measurements.

Watts Selects Watts format.
This soft key will only be selectable for absolute power measurements.

VSWR

Selects VSWR format.
This soft key will only be selectable for relative power measurements (i.e. a ratio).

Volts

Selects Volts format. The instrument displays the DC voltage output from the detector (or voltage adaptor cable).
This soft key will only be selectable for single input power measurements.

[SCALING] KEY

The [SCALING] key provides a menu which enables the user to adjust the positioning and scaling of the currently active trace in the currently active channel, or to allow the instrument to set the scaling automatically.

Fig. 3-29 SCALING Menu - Scalar Channel

Scaling

This menu enables the user to set the reference level and scaling for a trace. The reference position is the position on the vertical axis that remains fixed during scaling. This is indicated on the screen by the Reference Position Indicator (see the 'Display' Section). The reference level is the value corresponding to the position of the Reference Position Indicator on the vertical scale, and is displayed in the relevant trace information area.

The default values for reference level and scaling factor for each type of format are listed below. Except for the VSWR format the default reference position in each case is the top graticule line.

Format	Reference Level	Scale Factor
dB and dBm	+20.0	10.0 dB(m)/div
VSWR*	1	0.1 /div
mW	100	10.0 mW/div
Volts	1	0.1 V/div
Linear Frequency	20.0 GHz	2.0 GHz/div

*Reference position is the bottom graticule line.

The parameters in this menu apply per trace.

Autoscale

Allows the instrument to determine optimum values of scale and reference level. The value chosen for the scale factor will be selected from a 1,2,5 sequence. The value chosen for the reference level will be a multiple of the scaling factor. The reference position will remain unchanged.

Set Scale

Used to set the scale factor for a trace.

dB/dBm Formats

Rotary Control	Step Keys	Numeric Pad	Terminator
√	√	√	Any

VSWR, mV and Volts Formats

Rotary Control	Step Keys	Numeric Pad	Terminator
√	√	√	10⁻

Linear Frequency Format

Rotary Control	Step Keys	Numeric Pad	Terminator
√	√	√	10+

Set Ref Level

Used to set the reference level for a trace.

Numeric entry as above.

The reference level can also be set to the response measured at the active marker position, by pressing this soft key followed by the [×1] key on the numeric keypad.

Set Ref Position

Used to set the reference position for a trace. The reference position may be placed on any of the 11 horizontal lines on the graticule.

Rotary Control	Step Keys	Numeric Pad	Terminator
√	√	×	×

Continuous Autoscale

Toggles continuous autoscale on or off, in which autoscaling will be performed automatically once per measurement update.

[MARKERS] KEY

The MTS can display up to eight markers per trace, with each marker identified by a number. Any one of these can be designated the active marker, indicated by a box around the number to distinguish it from the normal markers. The active marker can be moved along the x-axis using the step keys, rotary control or by keyboard entry. The step keys and keyboard entry are only available through the Position Active Mkr and Position Delta Mkr functions of the Markers Menu. The rotary control can be used to move the active marker at any time whilst it is displayed, provided that no other from of numeric entry is active. The domain value (x-axis position) of the active marker is displayed below the graticule, and the measured response at this position is displayed in the relevant trace information area.

The delta marker mode provides an additional marker, designated the delta marker, and is represented by Δ on the display. In this mode, the domain value of the active marker is relative to the delta marker position. The measured response is relative to the response at the delta marker position, i.e.

Domain value = Active Marker position – Delta Marker position
Response = Active Marker response – Delta Marker response

The marker menus are shown in Fig. 3-31.

A tracking facility is available for the max/min, peak-to-peak and bandwidth functions. This enables the function to be automatically applied at each measurement update (i.e. at the end of each sweep).

Markers

This menu provides soft keys for setting up markers and using them to perform various types of measurement.

Active Mkr

Toggles the active marker on or off. Turning off the active marker also turns off the delta marker. Once the active marker is turned on it can be positioned anywhere along the graticule using the rotary control. To set the active marker to a specific domain value using the numeric keypad the *[Position Active Mkr]* soft key must be selected.

Place Mkr at Active

Used to place a marker at the active marker position by entering the required marker number.

Rotary Control	×	Step Keys	×	Numeric Pad	√	Terminator	None

This soft key will only be selectable if the active marker is turned on.

Position Active Mkr

Used to change the domain value (x-axis position) of the active marker, by entering the new value as follows:

Frequency

Rotary Control	√	Step Keys	√	Numeric Pad	√	Terminator	10+

Power

Rotary Control	√	Step Keys	√	Numeric Pad	√	Terminator	Any

Voltage, Current

Rotary Control	√	Step Keys	√	Numeric Pad	√	Terminator	10–

This soft key will only be selectable if the active marker is turned on.

Delta Mkr

Toggles the delta marker on or off. Turning on the delta marker also turns on the active marker.

Position Delta Mkr

Used to change the position of the delta marker, using the same method as for the active marker.
This soft key will only be selectable if the delta marker is turned on.

All Mkrs Off

Turns off all the markers for the currently active trace.

Mkr Functions

Leads to the Mkr Funcs Menu, which enables various measurement functions to be carried out by means of the active marker and delta marker.
See page 3-97.

Set Up Mkrs

Leads to the Set Up Mkrs Menu, which allows the user to activate and position selected markers.
See page 3-103

Mkr Funcs

This menu leads to sub-menu for locating the maximum and minimum points on a trace, measuring the peak to peak ripple, searching for a specified response value and performing bandwidth measurements, and measuring the slope of a trace.

Marker to Max Min

Leads to the Max Min Menu.
See page 3-98.

dB/Octave dB/Decade

Leads to the dB/O dB/D Menu.
This soft key is only selectable if the domain is frequency, start frequency is < stop frequency, and format is dB/dBm.
See page 3-98.

Peak to Peak

Leads to the Peak to Peak Menu, which enables measurement of peak to peak ripple.
This soft key is only selectable if the format is dB/dBm.
See page 3-99.

Search

Leads to the Search Menu, which is used to locate a response value on the trace.
See page 3-100.

Bandwidth

Leads to the Bandwidth Menu, which is used for bandwidth measurements.
This soft key is only selectable if format is dB/dBm, and the sweep type is frequency.
See page 3-101.

Find Next Peak

Unselectable.

Return to Markers

Returns control to the Markers Menu.

MARKERS | Mkr Functions | Marker to Max Min

Max Min

This menu is used to locate the maximum and minimum points on a trace.

When the tracking facility is turned on, the selected function as applied automatically at the end of each sweep, thus continually updating the maximum or minimum function.

Active Mkr to Maximum — Moves the active marker to the maximum point on the displayed trace.

Active Mkr to Minimum — Moves the active marker to the maximum point on the displayed trace.

Tracking Maximum — Applies tracking to the maximum function.

Tracking Minimum — Applies tracking to the minimum function.

Tracking Off — Disables tracking.

Return to Markers — Returns control to the Mkr Funcs Menu.

MARKERS | Mkr Functions | dB / Octave dB / Decade

dB/O dB/D

This menu enables the marker response to be set up to display the slope of the trace at the active marker position. This function applies per measurement.

dB/Octave — Enables the marker response to be displayed as dB per octave.

dB/Decade — Enables the marker response to be displayed as dB per decade.

Off — Restores normal marker response display.

Return to Mkr Funcs — Returns control to the Mkr Funcs Menu.

Peak to Peak

This menu enables measurement of the peak to peak ripple of a displayed trace. The system performs this function by enabling the delta mode and positioning the active marker and delta marker at the trace maximum and minimum respectively. A limit check can be performed on the peak to peak measurement by comparing it with a user-defined limit value.

When the tracking facility is turned on, the peak to peak function is applied automatically at the end of each sweep, thus continually updating the peak-to-peak measurement.

Find Pk - Pk

Initiates the peak to peak measurement and displays the result in a form overlaying the graticule. If limit checking is enabled, a pass/fail indication is also displayed in this form. The form is removed if there is any change in the trace or markers, or if the [ENTRY OFF] key is pressed.

Set Pk - Pk Limit Value

Used to set the limit value that the peak to peak measurement is to be checked against. A value in the range 0 to +99.99 dB can be entered.

Rotary Control √	Step Keys √	Numeric Pad √	Terminator Any

Pk - Pk Limit Checking

Toggles limit checking on or off.

Tracking

Toggles the tracking function on and off.

Return to Mkr Funcs

Returns control to the Mkr Funcs Menu.

Search

This menu is used for locating a response value on the trace that has previously been specified by the user. The search facility can also be used in delta marker mode.

Search Left

Causes the system to search left from the current active marker position in order to find the response value specified with the *[Set Search Value]* soft key. The active marker will be placed at this position. If two adjacent measurement points encompass the search value, the active marker will be placed at the measurement point which is nearer to the search value. If the search value cannot be found, a message will be displayed indicating this, and the active marker will not be moved.

Search Right

As above, but the search direction is right.

Set Search Value

Sets the value that will be searched for.

dB/dBm formats

Rotary Control √	Step Keys √	Numeric Pad √	Terminator Any

VSWR, mV and Volts formats

Rotary Control √	Step Keys √	Numeric Pad √	Terminator 10^{-}

Linear Frequency format

Rotary Control √	Step Keys √	Numeric Pad √	Terminator 10^{+}

Return to Mkr Funcs

Returns control to the Mkr Funcs Menu.

Bandwidth

This menu enables the bandwidth to be determined corresponding to N dB points, where N can be a positive or negative value entered by the user.

If the search value is a negative dB value, pressing this soft key initiates both a right and left search simultaneously starting from the maximum point on the trace. If the search value is a positive dB value the searches are performed similarly, but starting from the minimum point on the trace. It is also possible to measure the bandwidth by starting the search from the active marker position.

If the bandwidth function is successful, marker number 7 will be placed at the lower frequency N dB point, and marker number 8 will be placed at the upper frequency N dB point. Fig. 3-30 shows the displayed results of a bandwidth measurement on a band-pass filter.

If the tracking facility is turned on, the bandwidth function is applied automatically at the end of each sweep, thus continually updating the bandwidth measurement.

Bandwidth Search

Initiates the bandwidth search and displays the result in a form overlaying the graticule. The form is removed if there is any change in the measurement or markers, or if the [ENTRY OFF] key is pressed.

Set n dB Value

Used to set the dB value for the bandwidth search.

Rotary Control √	Step Keys √	Numeric Pad √	Terminator Any

Display CF/ΔF

When this function is enabled, the ratio of centre frequency to bandwidth is displayed together with the bandwidth search result. This function applies instrument-wide.

Search from Max Min

When this function is enabled, the bandwidth is measured by starting the search from a maximum or minimum point on the trace, depending on whether the search value is a negative or positive dB value.

Search from Active Mkr

When this function is enabled, bandwidth is measured by starting the search from the active marker position.

Tracking

Toggles the tracking function on and off.

Return to Mkr Funcs

Returns control to the Mkr Funcs Menu.

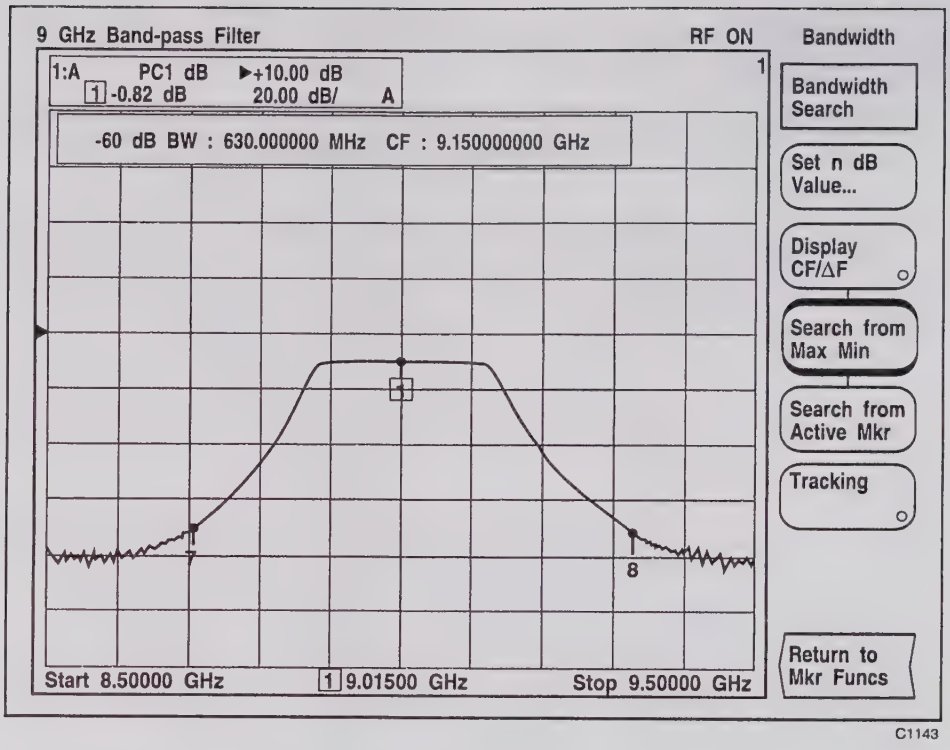

Fig. 3-30 Bandwidth Measurement of a Band-pass Filter

Set Up Mkrs

This menu enables selected markers to be turned on or off and positioned on the display, and allows one of the markers to be selected as the active marker. For frequency sweep measurements, the menu provides two alternative display resolutions for marker positions. A soft key is also provided to turn marker coupling between channels on or off.

Assign Active Mkr 1-8

Used to select the marker which will act as the active marker.

Rotary Control	Step Keys	Numeric Pad	Terminator
×	×	√	None

Mkr 1-8 On

Turns a selected marker on by entering the required marker number.

Rotary Control	Step Keys	Numeric Pad	Terminator
×	×	√	None

Mkr 1-8 Off

Turns a selected marker off by entering the required marker number.

Rotary Control	Step Keys	Numeric Pad	Terminator
×	×	√	None

Position Mkr 1-8

Used to change the domain value (x-axis position) of a specified marker. A form is displayed on the screen containing numeric entry fields for the marker number and the marker position. The required marker is first selected, then its position is changed.

Marker Number

Rotary Control	Step Keys	Numeric Pad	Terminator
×	×	√	None

Marker Position (Frequency Domain)

Rotary Control	Step Keys	Numeric Pad	Terminator
√	√	√	Any

Marker Position (Power Domain)

Rotary Control	Step Keys	Numeric Pad	Terminator
√	√	√	Any

Marker Position (Voltage or Current Domain)

Rotary Control	Step Keys	Numeric Pad	Terminator
√	√	√	10–

This soft key will only be selectable if at least one of the markers is turned on.

6 Digits Resolution

Sets the displayed resolution for marker frequency information to six digits.
This soft key is only selectable when the domain is frequency.

1 Hz Resolution

Sets the displayed resolution for marker frequency information to 1 Hz.
This soft key is only selectable when the domain is frequency.

Mkr Coupling

Toggles marker coupling between channels on or off. When marker coupling is enabled, the positions (i.e. domain or x-axis values) of all markers on all traces will track the positions of the markers on the active trace of the active channel. When marker coupling is disabled, markers may be positioned independently on each channel. The default setting for marker coupling is on.
Marker coupling can only be disabled when channel coupling is switched off (Channel Mode Menu).

Return to Markers	Returns control to the Markers Menu.

Fig. 3-31 MARKERS Menus - Scalar Channel

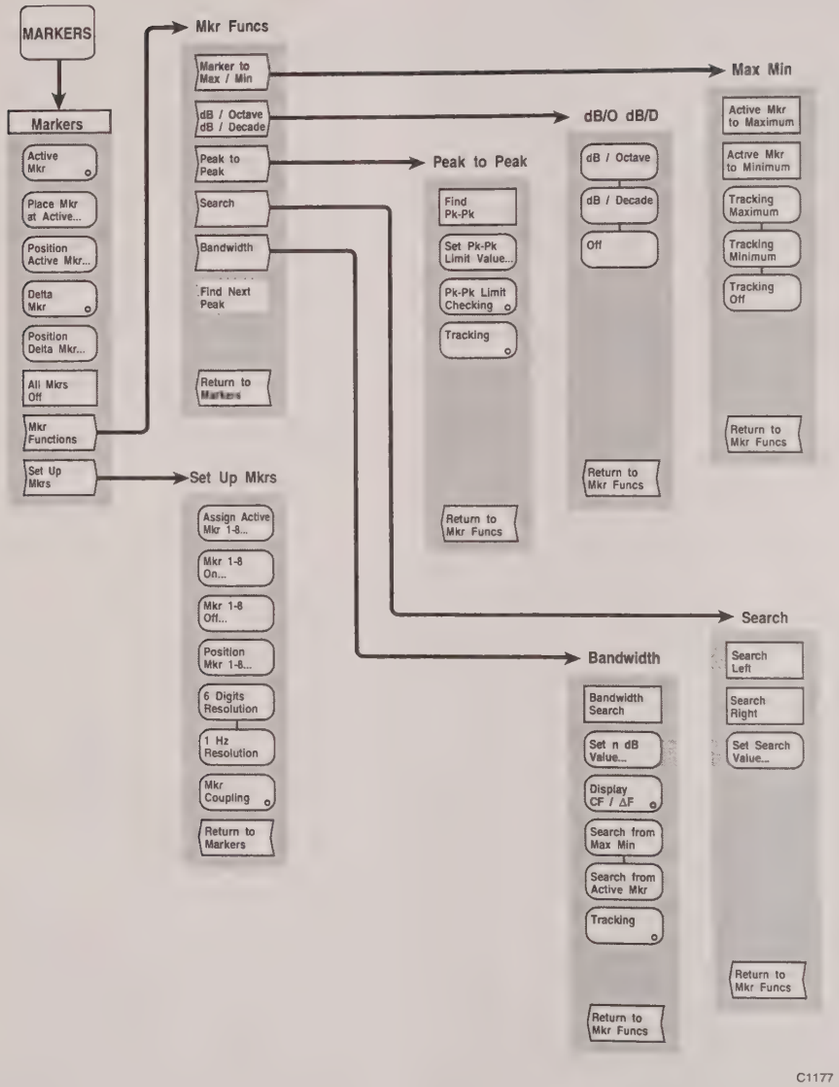

Fig. 3-31 MARKERS Menus - Scalar Channel

FUNCTION GROUP KEYS - READOUT CHANNEL

[SOURCE] KEY

The menus accessed by the [SOURCE] key are the same as for a scalar channel.

[MEASURE] KEY

The [MEASURE] key provides access to the series of menus illustrated in Figs. 3-32 to 3-35, which are used to define and set up the readout measurement and apply various functions to aid examination of the results.

The current values or states for the major measurement functions are displayed in specific locations on the screen (see 'Display' earlier in this chapter).

Measure	*See Fig. 3-32* **This menu provides access to sub-menus for setting up the readout measurement and analyzing the results.**
Power Meter	When this soft key is pressed, the quantity that will be measured and displayed is the power level detected by a power sensor connected to Input D.
Counter	When this soft key is pressed, the quantity that will be measured and displayed is the frequency of the signal present at the COUNTER input.
dB Rel or **Frequency Rel**	This soft key is labelled *[dB Rel]* if the active measurement is a power meter reading, or *[Frequency Rel]* if it is a counter reading. When this soft key is pressed, the dB Rel Menu or Freq Rel Menu is presented which enables a measurement to be made relative to a value held in a relative measurement store. *See page 3-109.*
Averaging	Leads to the Averaging Menu, which enables averaging to be applied to power measurements. *This soft key will only be selectable for power meter readings.* *See page 3-110.*
Restart Averaging	Restarts the averaging process. See also the Averaging Menu (Page 3-110).
Reset Peak Indicator	Causes the peaking indicator to be reset such that the current power measurement will give half full scale reading. *This soft key is unselectable if the currently active readout is a frequency measurement or a difference measurement.*
Measurement Functions	Leads to the Meas Funcs Menu, which enables the basic measurement configuration to be set up. *See page 3-112.*
General Set-up	Leads to the Gen Set-up Menu, which enables the user to set up the input configuration and to compensate for detector/sensor characteristics. *See page 3-116.*

MEASURE **dB Rel**

dB Rel — *See Fig. 3-32.* **Enables a power measurement to be made relative to a value held in a relative measurement store (analogous to trace memory for swept measurements). This function applies per readout.**

Store Measurement — Causes the current readout measurement to be stored in the relative measurement store (this store is separate from the one used for relative frequency measurements). It will also turn on the relative measurement mode if it is off.

Relative Meas — Toggles the relative measurement mode on or off, without affecting the contents of the relative measurement store. The relative measurement mode is indicated by an "R" flag above the displayed readout value, and is also indicated on hard copy output.

Return to Measure — Returns control to the Measure menu.

MEASURE **Frequency Rel**

Freq Rel — *See Fig. 3-32.* **Enables a frequency measurement to be made relative to a value held in a relative measurement store. This function applies per readout.**

Store Measurement — Causes the current readout measurement to be stored in the appropriate relative measurement store (this store is separate from the one used for relative power measurements). It will also turn on the relative measurement mode if it is off.

Relative Meas — Toggles the relative measurement mode on or off, without affecting the contents of the relative measurement store. The relative measurement mode is indicated by an "R" flag above the displayed readout value, and is also indicated on hard copy output.

Return to Measure — Returns control to the Measure menu.

Averaging

See Fig. 3-32. **Averaging is used to reduce the effects of noise on a power meter reading. The minimum amount of averaging should be selected to reduce noise to an acceptable level, in order to maintain a sufficiently fast response time.**

Each new measurement is averaged into the previous average value until the measurement count is equal to the user-entered average number, for a fully averaged reading. This condition is indicated by the 'A' flag in the relevant readout information area. The flag is in lower case until this condition is reached. It is absent if the averaging function is turned off.

Note...

The averaging process can be re-started by using the *[Restart Averaging]* soft key in the MEASURE MENU.

Input A — Leads to the Input A Menu, which enables averaging to be applied to input A.

Input B — Leads to the Input B Menu, which enables averaging to be applied to input B.

Input C — Leads to the Input C Menu, which enables averaging to be applied to input C.

Input D — Leads to the Input D Menu, which enables averaging to be applied to input D.

Return to Measure — Returns control to the Measure Menu.

Input A (B, C or D)

See Fig. 3-32. **These menus are identical, and are used to apply averaging to the input, and to select the resolution to which the power meter reading is displayed.**

The time taken for averaging to complete depends upon the resolution to which the readout is displayed. A choice of display resolutions is available, which provide a trade-off between resolution and averaging time (lower resolution gives faster averaging).

Automatic Averaging

Sets the averaging mode to automatic, in which the average number will be chosen automatically from a range of values depending on the power range being measured and the power sensor type. Averaging will restart automatically when the input power has deviated from the current average value by a certain amount. When automatic averaging is enabled, the MTS will, by default, display the highest resolution possible (0.001 dB).

0.01 dB Resolution

Selects 0.01 dB resolution for the readout.

0.1 dB Resolution

Selects 0.1 dB resolution for the readout.

1 dB Resolution

Selects 1 dB resolution for the readout.

User Set Averaging

Allows the user to enter the average number from the keyboard, using the *[Set Average Number]* soft key.

Averaging Off

Turns averaging off for the selected input.

Set Average Number

Enables selection of the average number to be used in the averaging function, by entering values in the range 1 to 1000.
This soft key will only be selectable if User Set Averaging has been selected.

Rotary Control √	Step Keys √	Numeric Pad √	Terminator Any

Return to Averaging

Returns control to the Averaging Menu.

Meas Funcs

See Fig. 3-33. **This menu is used to specify whether the system is to measure the absolute power level of a single input, the ratio of two input power levels or the difference between two input power levels.**

Single Input A, B, C or D

Leads to the Single Input Menu.
See page 3-113.

Input Ratio

Leads to the Input Ratio Menu.
See page 3-113.

Input Difference

Leads to the Input Diff Menu.
See page 3-114.

Duty Cycle Correction

Leads to the Duty Cycle Menu, which enables duty cycle correction to be applied to power measurements when measuring the peak power of a pulsed signal.
This soft key will only be selectable for power meter readings.
See page 3-114.

Limit Checking

Leads to the Lim Checking Menu, which enables measurements to be compared with user-defined maximum and minimum limits.
See page 3-115.

Max Min Hold

Leads to the Max Min Hold Menu, which finds the maximum and minimum power or frequency readings over a period of time.
See page 3-115.

Counter Resolution

Pressing this soft key leads to a sub-menu which is used to select the resolution to which the counter readout is displayed. The resolution can be set between 1 Hz and 100 MHz (in decades). The default setting is 100 kHz.

Return to Measure

Returns control to the Measure Menu.

MEASURE **Measurement Functions** **Single Input A, B, C or D**

Single Input

See Fig. 3-33. **Enables the power level at a selected input to be measured by pressing the appropriate soft key. The power level can be displayed in dBm or Watts, as selected from the Format Menu ([FORMAT] key).**

A Selects input A for power measurement.

B Selects input B for power measurement.

C Selects input C for power measurement.

D Selects input D for power measurement.

Return to Meas Funcs Returns control to the Meas Funcs Menu.

MEASURE **Measurement Functions** **Input Ratio**

Input Ratio

See Fig. 3-33. **Enables the ratio of the power levels at two of the inputs to be measured by selecting the appropriate soft keys. The power ratio can be displayed in dB or as a percentage, as selected from the Format Menu**

A / Selects input A as the numerator of the desired power ratio measurement. Selecting the numerator leads to a sub-menu where the denominator is chosen (B, C or D).

B / Selects input B as the numerator of the desired power ratio measurement. Selecting the numerator leads to a sub-menu where the denominator is chosen (A, C or D).

C / Selects input C as the numerator of the desired power ratio measurement. Selecting the numerator leads to a sub-menu where the denominator is chosen (A, B or D).

D / Selects input D as the numerator of the desired power ratio measurement. Selecting the numerator leads to a sub-menu where the denominator is chosen (A, B or C).

Return to Meas Funcs Returns control to the Meas Funcs Menu.

Input Diff

See Fig. 3-34. **Enables the difference between the power levels at two of the inputs to be measured by selecting the appropriate soft keys. The power difference can be displayed in Watts only.**

A – Selects input A as the minuend of the differential measurement. Selecting the minuend leads to a sub-menu where the subtrahend is chosen (B, C or D).

B – Selects input B as the minuend of the differential measurement. Selecting the minuend leads to a sub-menu where the subtrahend is chosen (A, C or D).

C – Selects input C as the minuend of the differential measurement. Selecting the minuend leads to a sub-menu where the subtrahend is chosen (A, B or D).

D – Selects input D as the minuend of the differential measurement. Selecting the minuend leads to a sub-menu where the subtrahend is chosen (A, B or C).

Return to Meas Funcs Returns control to the Meas Funcs Menu.

Duty Cycle

See Fig. 3-33. **The power meter measures the average power of a signal. To measure the peak power of a pulsed signal, correction must be applied to compensate for the duty cycle of the waveform. The MTS calculates the peak power using:**

Peak Power = Average Power × 100 / Duty Cycle

If duty cycle correction is enabled, the current duty cycle value will be displayed.

Duty Cycle Toggles duty cycle correction on or off for the currently active power meter measurement.

Set Duty Cycle Value Used to set the duty cycle correction value for the currently active power meter measurement.

Rotary Control √	Step Keys √	Numeric Pad √	Terminator Any

Return to Meas Funcs Returns control to the Meas Funcs Menu.

MEASURE **Measurement Functions** **Limit Checking**

Lim Checking

See Fig. 3-33. **This menu is used to check the measurement against preset maximum and minimum limits held in store. When limit checking is enabled, each new measurement is compared with both limits. A window is displayed above the relevant readout value showing the pass/fail status of the current measurement. The maximum and minimum limit values are displayed to the left of the readout. The pass/fail window and limit values are not displayed if limit checking is turned off for that readout.**

Limit Checking

Toggles limit checking on or off for the currently active readout.

Set Max Limit

Used to change the maximum limit value for the currently active readout. The new value is entered as follows:

Frequency

Rotary Control √	Step Keys √	Numeric Pad √	Terminator	10+

Watts

Rotary Control √	Step Keys √	Numeric Pad √	Terminator	10–

dB, dBm, Percentage

Rotary Control √	Step Keys √	Numeric Pad √	Terminator	Any

Set Min Limit

As above but applies to the minimum limit.

Return to Meas Funcs

Returns control to the Meas Funcs Menu.

MEASURE **Measurement Functions** **Max Min Hold**

Max Min Hold

See Fig. 3-33. **Provides a facility which finds and stores the maximum and minimum power or frequency readings over a period of time. When this function is enabled, each new measurement is compared with both stores. If the new measurement is less than that held in the min hold store or greater than that held in the max hold store, the store will be overwritten by the new measurement. This function applies per readout.**

Hold

Toggles the max/min hold facility on or off.

Clear

Causes both the min hold and max hold stores to be set to the current measurement.

Return to Meas Funcs

Returns control to the Meas Funcs Menu.

Gen Set-up

See Fig. 3-35. **This menu enables the user to set up the input configuration and to compensate for non-ideal characteristics of detectors and sensors.**

Input Configuration

Leads to the Input Config Menu, which is used to set up the input configuration for the measurement.
See page 3-117.

Domain Scale & Offset

This soft key is unselectable.

Detector Correction

Leads to the Select Input Menu, which is used to compensate for non-ideal detector characteristics.
See page 3-65.

Sensor Correction

Leads to the Sensor Corr Menu, which is used to apply cal factor and linearity correction for the power sensor connected to the D input.
This soft key will only be selectable if Input D is configured for a power sensor.
See page 3-67.

Det / Sensor Specs

Leads to the Edit Specs Menu, which is used to modify detector correction specifications or sensor calibration data tables.
See page 3-69.

AC Detection

Unselectable for a readout channel.

DC Detection

Unselectable for a readout channel.

Return to Measure

Returns control to the Measure Menu.

Input Config

See Fig. 3-35. **This menu provides the following functions for setting up the configuration of the four inputs.**

All Inputs are Scalar

Configures all four inputs A, B, C and D to accept scalar detectors.

Input D is Power Sensor

Configures inputs A, B and C to accept scalar detectors and input D to accept power meter sensor.

Input A Offset

Enables the offset for Input A to be changed.

Rotary Control	Step Keys	Numeric Pad	Terminator
×	×	√	Any

Input B Offset

Enables the offset for Input B to be changed.

Rotary Control	Step Keys	Numeric Pad	Terminator
×	×	√	Any

Input C Offset

Enables the offset for Input C to be changed.

Rotary Control	Step Keys	Numeric Pad	Terminator
×	×	√	Any

Input D Offset

Enables the offset for Input D to be changed.

Rotary Control	Step Keys	Numeric Pad	Terminator
×	×	√	Any

View Current Configuration

Displays a form on the screen showing the detector or sensor type connected to each input, and whether manual or automatic correction will be applied (see Select Input Menu, page 3-65). Pressing the *[Return to Input Config]* soft key returns control to the Input Config Menu.

Return to Gen Set-up

Returns control to the Gen Set-up Menu.

Fig. 3-32 MEASURE Menus - Readout Channel (Sheet 1)

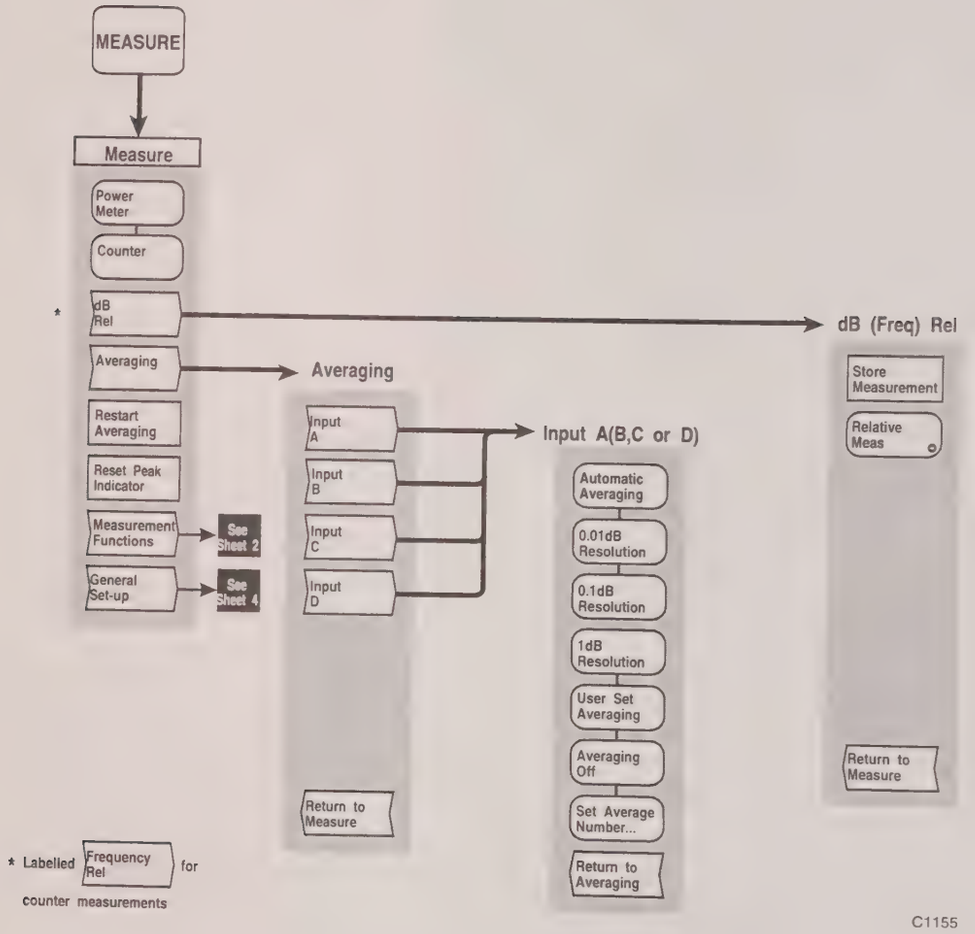

Fig. 3-32 MEASURE Menus - Readout Channel (Sheet 1)

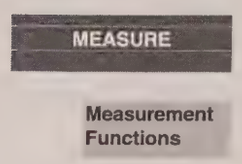

Fig. 3-33 MEASURE Menus - Readout Channel (Sheet 2)

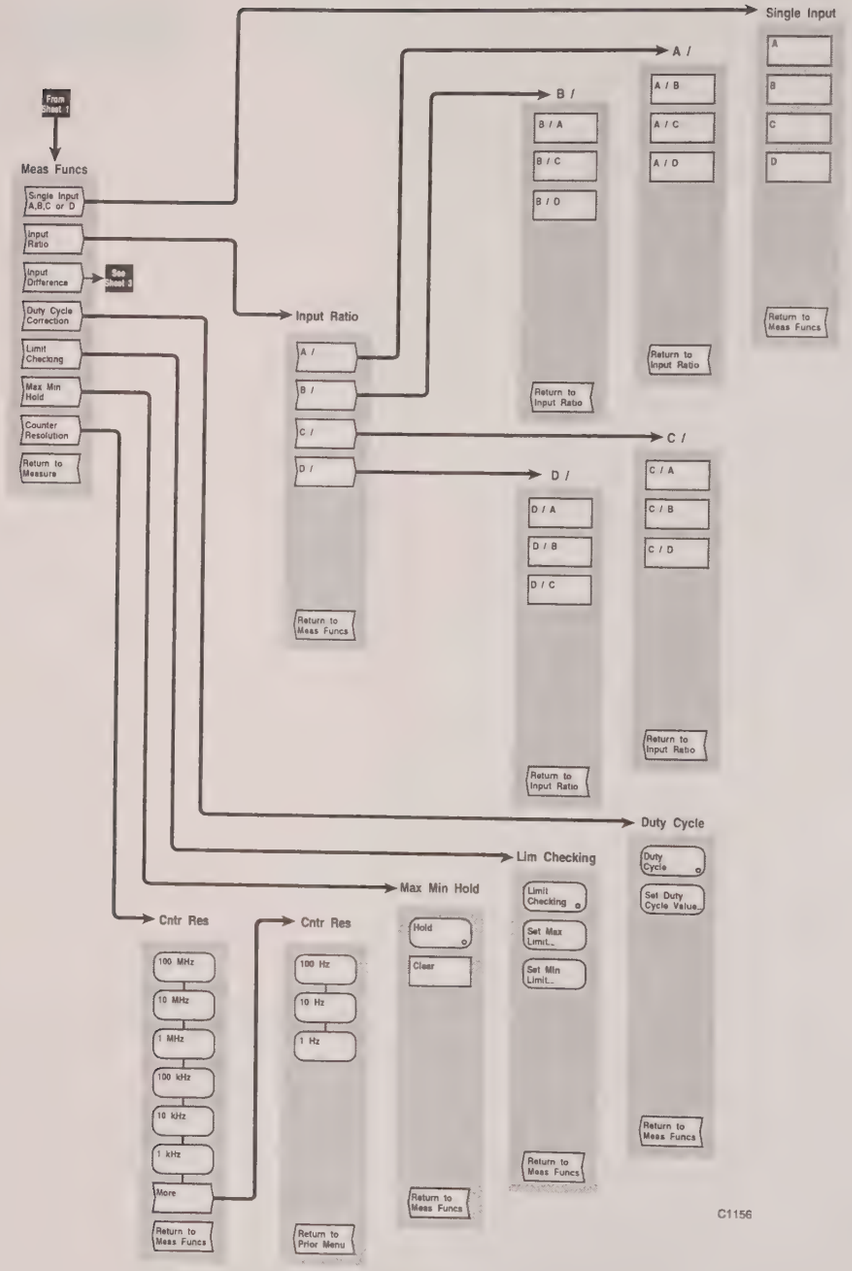

Fig. 3-33 MEASURE Menus - Readout Channel (Sheet 2)

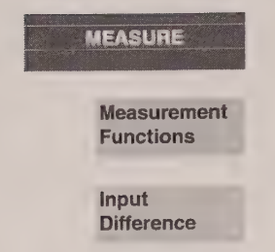

Fig. 3-34 MEASURE Menus - Readout Channel (Sheet 3)

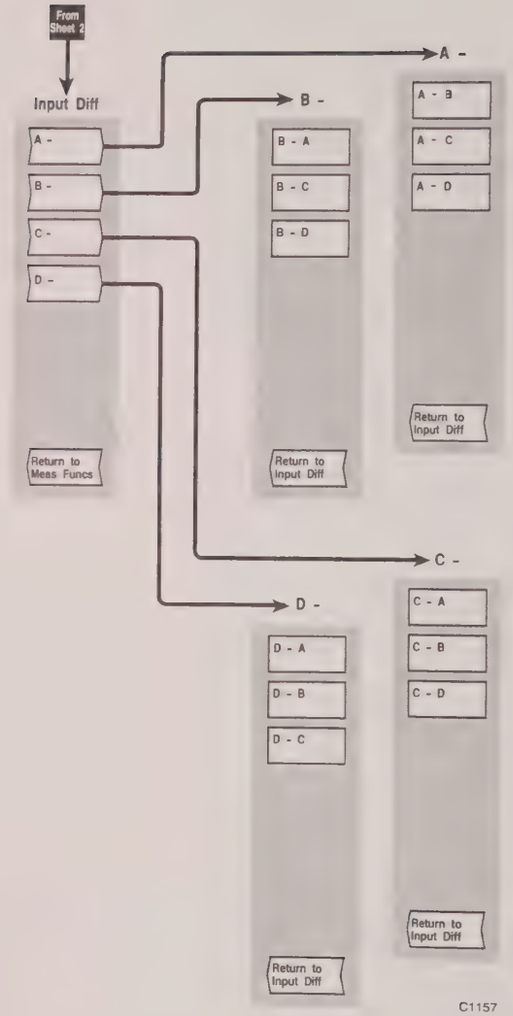

Fig. 3-34 MEASURE Menus - Readout Channel (Sheet 3)

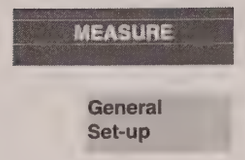

Fig. 3-35 MEASURE Menus - Readout Channel (Sheet 4)

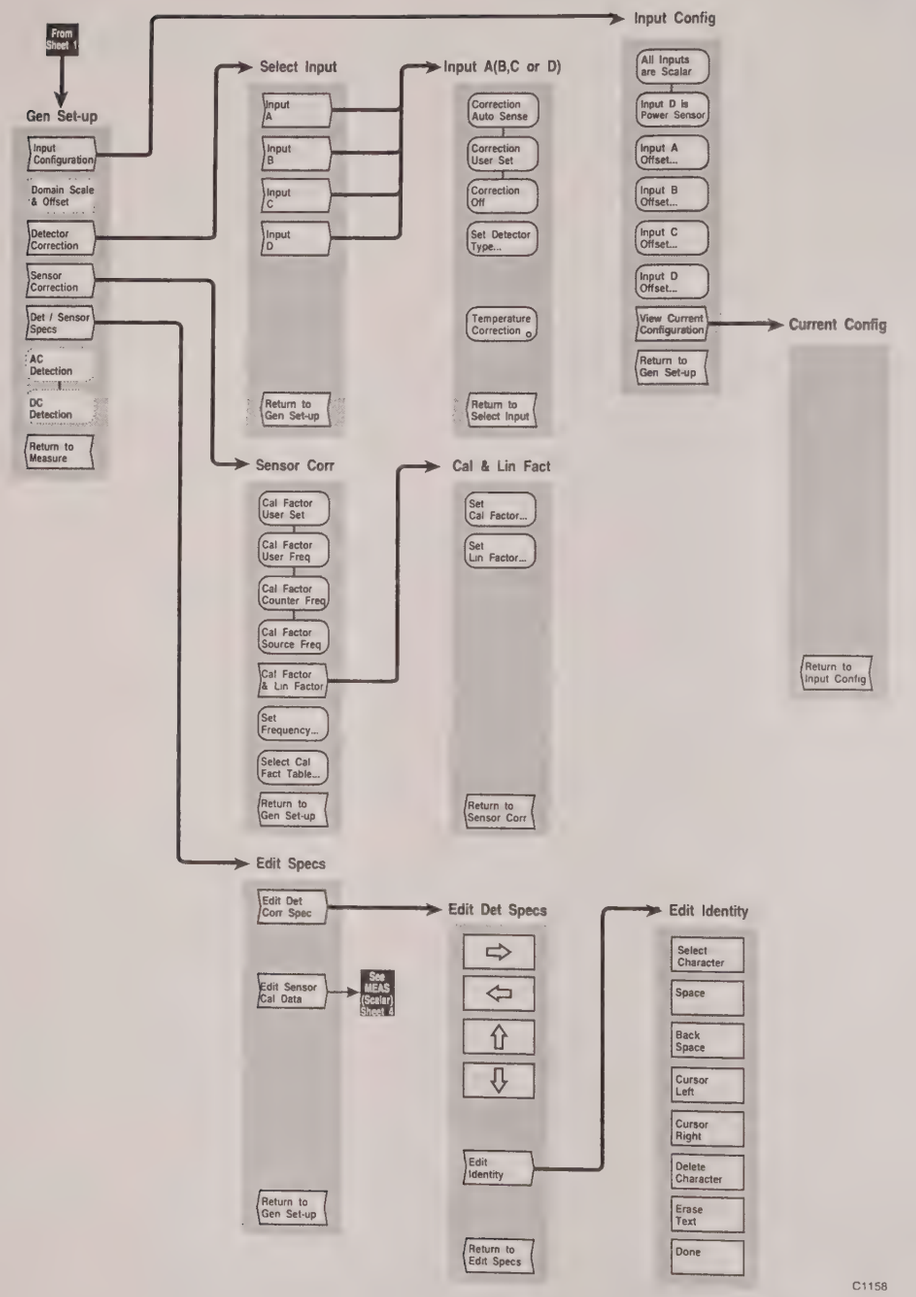

Fig. 3-35 MEASURE Menus - Readout Channel (Sheet 4)

[CAL] KEY

The [CAL] key is used to perform a power sensor calibration for a readout channel. Power sensor calibration utilises the 50 MHz, 1 mW power reference output available from the front panel. A sensor is calibrated by connecting it to the power reference output (via a 30 dB attenuator for 6920 series sensors) and pressing the [Sensor Cal] soft key. The system measures the difference between the sensor and reference outputs and uses this to correct subsequent measurements. The power reference will be switched on and off automatically as required by the calibration process.

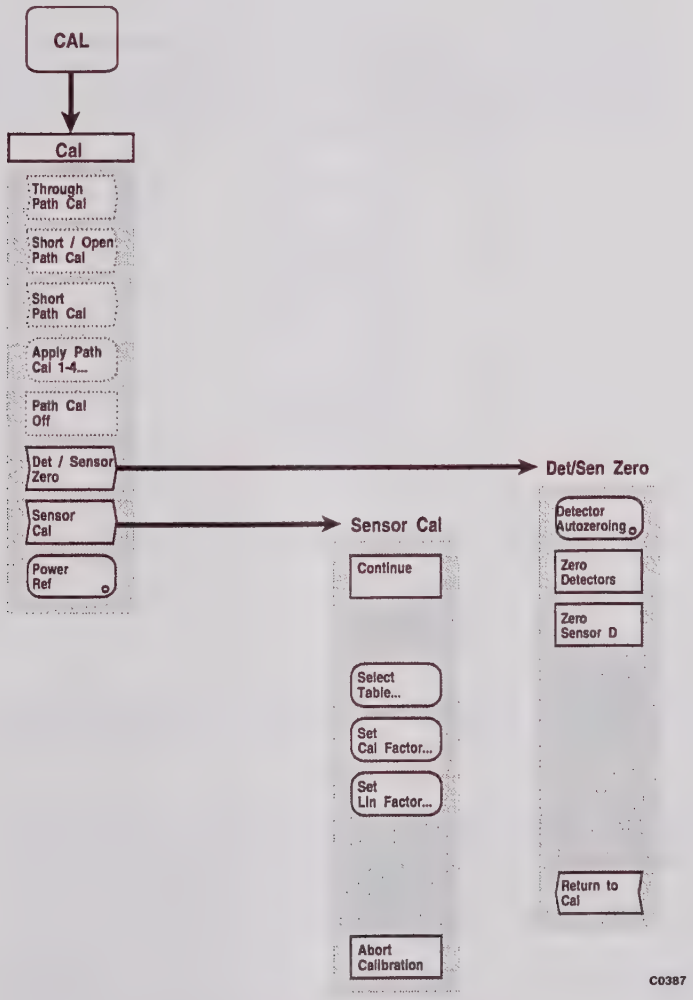

Fig. 3-36 CAL Menu - Readout Channel

Cal

This menu is used for detector/sensor zeroing and sensor calibration.

The first five soft keys in this menu are unselectable for a readout channel; only the three selectable soft keys are described here.

Det / Sensor Zero

Leads to the Det/Sen Zero Menu, which is used for zeroing detectors/sensors.
See page 3-87.

Sensor Cal

Leads to the Sensor Cal Menu, which is used to zero the power sensor and to calibrate it against the reference.
This soft key will only be selectable if Input D is configured for a power sensor.
See page 3-88

Power Ref

Toggles the power reference output on and off. The reference can be used, for example, to verify that the power sensor is functioning correctly. The Power Reference On indicator (PWRREF) will be present in the General Information Area at the top of the screen if a power reference signal is being output.

[FORMAT] KEY

The [FORMAT] key enables the active measurement in the active channel to be displayed in the required format. The options available depend upon the input configuration.

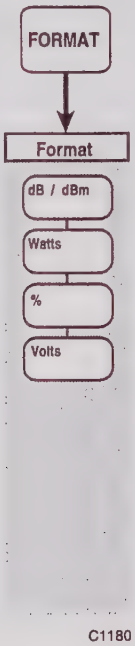

Fig. 3-37 FORMAT Menu - Readout Channel

FORMAT

Format — **The soft keys in this menu enable linear (Watts or %) or log (dB/dBm) display formats to be selected.**

dB / dBm — Selects dB/dBm format. The instrument will automatically select dB or dBm depending on whether the measurement is a ratio of inputs (i.e. relative power measurement) or a single input (i.e. absolute power measurement).
This soft key will only be selectable for absolute or relative power measurements.

Watts — Selects Watts format.
This soft key will only be selectable for absolute power or power difference measurements.

% — Selects percentage format.
This soft key will only be selectable for relative power measurements.

Volts — Selects Volts format. The instrument displays the DC voltage output from the detector (or voltage adaptor cable).
This soft key will only be selectable for single input power measurements.

FUNCTION GROUP KEYS - FAULT LOCATION CHANNEL

[SOURCE] KEY

The [SOURCE] key provides access to the series of menus illustrated in Fig. 3-38, which are used to define and control all the source functions for a fault location channel.

Due to the nature of the measurement the user does not have full control of the source for a fault location channel, other than setting the output power level, resulting in a simplified source menu, as described below. The parameters for setting the start and stop frequencies of the sweep and the number of measurement points are accessed via the fault location Measure menus.

Source

This menu enables the operator to set up the source for fault location measurements on coaxial or waveguide transmission lines. Unlike the scalar and readout channels there is only one source menu for fault location measurements.

Set Output Power

Used to change the output power of the source for the currently active channel.

Rotary Control √	Step Keys √	Numeric Pad √	Terminator	Any

Sweep Time

Leads to the Sweep Time Menu, which enables the sweep time to be set up manually or automatically.
See page 3-34.

RF

Toggles the RF output on or off for the currently active channel.

Source Functions

Leads to the Source Funcs Menu, which enables several options to be selected, allowing the source to be set up according to the requirements of a particular measurement. The Source Funcs Menu is the same as that for scalar and readout channels, except that the *[Int/Ext Source]* and *[Source Only Mode]* soft keys are not present.
See page 3-36.

Fig. 3-38 SOURCE Menus - Fault Location Channel

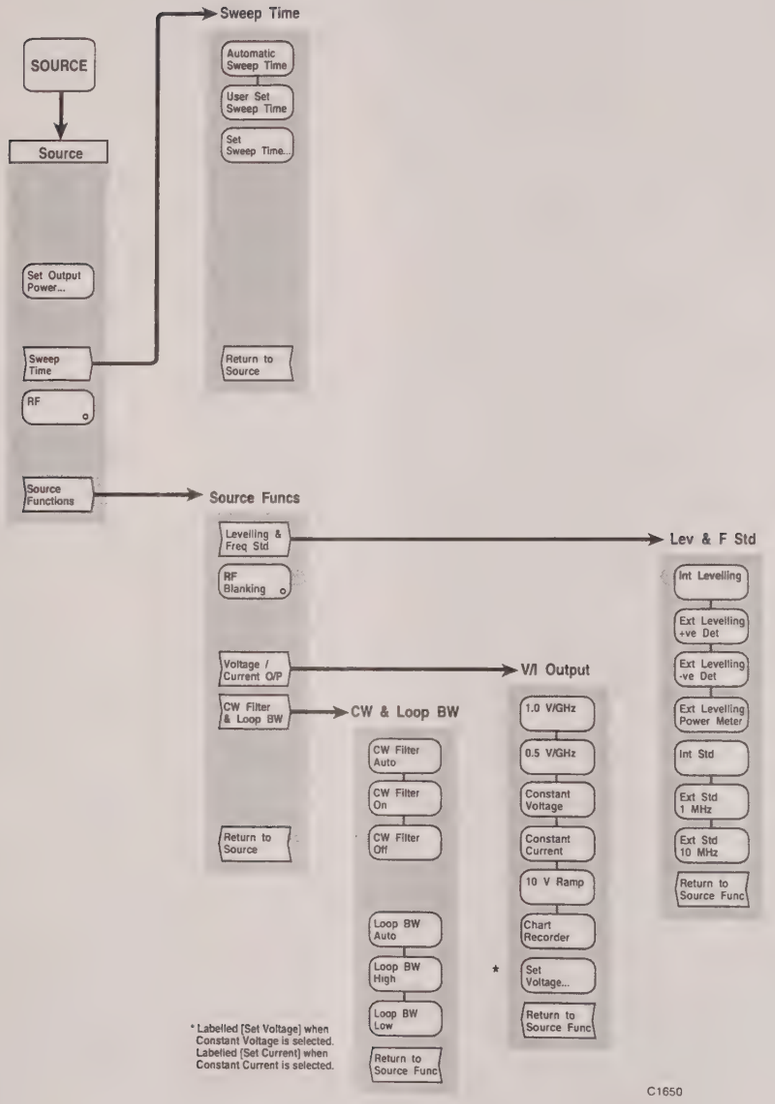

Fig. 3-38 SOURCE Menus - Fault Location Channel

[MEASURE] KEY

The [MEASURE] key provides access to the series of menus illustrated in Fig. 3-43 and Fig. 3-46 which are used to define and set up the fault location measurement, and apply various functions to aid examination of the results.

The current values or states for the major measurement functions are displayed in specific locations on the (see 'Display', page 3-14).

Values for cutoff frequency, relative velocity, overmode frequency and attenuation can be set directly using the Set Parameters Menu, or the instrument can set up these parameters from data contained in a transmission line database (see the Access Dbase Menu, page 3-142).

Measure — *See Fig. 3-43*

Configure Fault Loc
Leads to the Config F Loc Menu.
This key is only selectable if Measurement 1 is active.
See page 3-137.

Set Up Measurement
Leads to the Set Up Meas Menu.
This key is only selectable if Measurement 1 is active.
See page 3-139.

Averaging
Leads to the Averaging Menu, which enables averaging to be applied to the measurement data.
This soft key is only selectable if Measurement 1 is active.
See page 3-54.

Restart Averaging
Restarts the averaging process.
This key is only selectable if Measurement 1 is active.
See also the Averaging Menu (page 3-54).

Recall Cal Conditions
Recalls the measurement conditions that were present when the fault location calibration was performed.

Fault Loc Functions
Leads to the F Loc Funcs Menu.
This key is only selectable if Measurement 1 is active.
See page 3-151.

General Set-up
Leads to the Gen Set-up Menu.
This is the same as for a scalar channel, except that the *[Domian Scale & Offset]* soft key is unselectable.
This key is only selectable if Measurement 1 is active.
See page 3-62.

MEASURE → **Configure Fault Loc**

Config F Loc — *See Fig. 3-43*

Range Entry	Sets the entry mode to 'range entry' (see page 3-139).
Frequency Entry	Sets the entry mode to 'frequency entry' (see page 3-139).
Coax Medium	Sets the medium to coax. *This soft key will not be selectable if the transmission line database is on.*
Waveguide Medium	Sets the medium to waveguide. *This soft key will not be selectable if the transmission line database is on.*
Display Units Metres	Sets the distance units to metres. This applies instrument-wide.
Display Units Feet	Sets the distance units to feet. This applies instrument-wide.
Measurement Definition	Leads to the Meas Def Menu. *See page 3-137.*
Return to Measure	Returns control to the Measure Menu.

MEASURE → **Configure Fault Loc** → **Measurement Definition**

Meas Def — *See Fig. 3-44.* **Enables the ratio of the power levels at two of the inputs to be measured by selecting the appropriate soft keys.**

A ration of B/C is required when making a fault location measurement using a Test Head.

The instrument defaults to a ratio of B/C.

It will not be possible to select input D if it is configured to be a power meter sensor input.

Single Input A, B, C or D	Leads to the Single Input Menu. *See page 3-138*
Input Ratio	Leads to the Input Ratio Menu *See page 3-138*
Return to Config F Loc	Return control to the Config. F Loc Menu.

MEASURE | Configure Fault Loc | Measurement Definition | Single Input A, B, C or D

Single Input

See Fig. 3-44. **Enables the power level of a selected input to be measured by pressing the appropriate soft key. A single input measurement needs to be specified when using a divider/detector instead of a Test Head.**

It will not be possible to select input D if it is configured to be a power sensor input.

A — Selects input A for the measurement.

B — Selects input B for the measurement.

C — Selects input C for the measurement.

D — Selects input D for the measurement.

Return to Meas Def — Returns control to the Meas Def Menu.

MEASURE | Configure Fault Loc | Measurement Definition | Input Ratio

Input Ratio

See Fig. 3-44. **Enables the ratio of the power levels at two of the inputs to be measured by selecting the appropriate soft keys.**

A ratio of B/C is required when making a fault location measurement using a Test Head.

The instrument defaults to a ratio of B/C.

It will not be possible to select input D if it is configured to be a power meter sensor input.

A / — Selects input A as the numerator of the desired power ratio measurement. Selecting the numerator leads to a sub-menu where the denominator is chosen (B, C or D).

B / — Selects input B as the numerator of the desired power ratio measurement. Selecting the numerator leads to a sub-menu where the denominator is chosen (A, C or D).

C / — Selects input C as the numerator of the desired power ratio measurement. Selecting the numerator leads to a sub-menu where the denominator is chosen (A, B or D).

D / — Selects input D as the numerator of the desired power ratio measurement. Selecting the numerator leads to a sub-menu where the denominator is chosen (A, B or C).

Return to Meas Def — Returns control to the Meas Def Menu.

Set Up Meas

See Fig. 3-45 **This menu enables the basic measurement configuration to be set up for fault location measurements.**

A form is displayed on the screen (Fig. 3-39) showing the current values for the fault location measurement definition.

Set Up Measurement	
Range	: 100.000 m
Center Frequency	: 10.000000000 GHz
Start Frequency	: 9.850198145 GHz
Stop Frequency	: 10.149801854 GHz
Cutoff Frequency	: -
Relative Velocity	: 1.000
Overmode Frequency:	-
Number of Points	: 401

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Fig. 3-39 Fault Location Parameters

The soft keys displayed in the frist two positions depend upon whether the channel is in 'range entry' or 'frequency entry' mode, and whether the transmission medium is coax or waveguide, as selected in the Config F Loc Menu.

In the range entry mode (the default mode), the range is entered and this determines the frequency span over which the source is swept. The system will select a centre frequency as close as possible to the value currently set. A different band of frequencies may be chosen by adjusting the centre frequency, but the value of span (and hence range) will always be preserved. In the frequency entry mode, a frequency span can be entered by adjusting the start/stop values. The range will then be calculated from the entered span.

If waveguide medium has been selected from the Config F Loc Menu, the *[Set Cutoff Frequency]* soft key will be selectable (this is not required for coax medium).

If coax medium has been selected from the Config F Loc Menu, the *[Set Relative Velocity]* soft key will be selectable (this is not required for waveguide medium).

Note...

If any of the parameters defined by this menu or the Set Params Menu are changed subsequent to calibration, the calibration will become invalid and the path calibration must be repeated. An error message will be displayed to warn the user that this situation has occurred.

Range Entry Mode:

Set Range

The range is the length of the transmission line to be measured. If the line consists of several sections, the range should be set to the sum of the lengths of the individual sections. The distance range determines the frequency span of the measurement. The maximum range depends on cable or waveguide loss. The minimum range that can be entered depends on the frequency range available from the source, the number of measurement points and the relative velocity of the transmission medium. If the resulting frequency span results in one of the limits being exceeded, then the centre frequency is changed so that the frequencies are within limits.

Rotary Control √	Step Keys √	Numeric Pad √	Terminator	10+

Set Cntr Frequency

Used to change the centre frequency of the measurement. The centre frequency should be set within the operating frequency bandwidth of the transmission line being tested. The centre frequency can only be set to a value which will not result in the source going beyond its frequency limits.

Rotary Control √	Step Keys √	Numeric Pad √	Terminator	10+

Set Number of Points

Used to change the number of measurement points generated by the sweep for each channel, up to a maximum of 512 points. The number of measurement points determines the minimum range can be entered; decreasing the number of measurement points reduces the minimum range.

Rotary Control √	Step Keys √	Numeric Pad √	Terminator	Any

Database Set Parameters

Enables the transmission line database. While it is enabled, it will not be possible to alter any of the parameters that the database sets.

User Set Parameters

Disables the transmission line database, allowing the parameters to be set directly.

Access Database

Leads to he Access Dbase Menu, which is used to access all database functions.
See page 3-142.

Set Parameters

Leads to the Set Params Menu, which enables the user to set parameters manually.
This soft key is unselectable if the transmission line database is enabled.
See page 3-150.

Return to Measure

Returns control to the Measure Menu.

Frequency Entry Mode:

The menu is the same as for range entry except for the *[Set Start Frequency]* and *[Set Stop Frequency]* soft keys which replace the *[Set Range]* and *[Set Cntr Frequency]* soft keys.

Set Start Frequency

This parameter is the start frequency of the measurement.

Rotary Control √	Step Keys √	Numeric Pad √	Terminator 10+

Set Stop Frequency

This parameter is the stop frequency of the measurement.

Rotary Control √	Step Keys √	Numeric Pad √	Terminator 10+

Access Dbase

See Fig. 3-45. **This menu provides access to the fault location transmission line database.**

Transmission line data is provided on an optional memory card, and is organised by manufacturer, medium (coax or waveguide) and transmission line name. Parameters such as relative velocity, cutoff frequency and attenuation versus frequency are provided by the database. Data for a single transmission line can be stored into a non-volatile transmission line database store within the MTS; five of these stores are available.

To use the transmission line data from the database, it must be selected from either the card or one of these transmission line database stores. Once selected, it is stored in the 'currently selected transmission line store' (in non-volatile memory). This is the data that is used by the instrument, and remains valid until a new transmission line is selected.

If, at power-up, the transmission line database is on, the parameters will be set up from the 'currently selected transmission line store'. If this store is corrupted, invalid or empty, the transmission line database will be turned off.

A form is displayed giving all the data for the transmission line that is currently in use by the transmission line database (or would be used if the transmission line database was enabled). The form also displays the source of the transmission line data, i.e. memory card or MTS transmission line database store. In the latter case the store number is given. The form is for information only; the data displayed cannot be altered. Invalid data is indicated by the "-" symbol.

Select from Card
Leads to the Sel from Card Menu.
See page 3-143.

Select from Store
Used to select a transmission line database store, by entering the required store identity number. The selected data will be used until a new transmission line is selected from the card or a transmission line database store is selected

Copy from Card
Leads to the Cpy from Card Menu.
See page 3-146.

Edit Store
Leads to the Edit Store Menu.
See page 3-147.

Return to Set Up Meas
Returns control to the Set Up Meas Menu.

Sel from Card

See Fig. 3-45. **This menu allows selection of a transmission line from a memory card. The selected data will be used until a new transmission line is selected from the card or a transmission line database store is selected.**

A form is displayed giving the data for transmission lines that match the subset selection criteria (Select Subset Menu). The subset selection criteria is also shown on the form. The *[⇑], [⇓], [Page Up]* and *[Page Down]* soft keys are used to highlight the required transmission line; on pressing *[Select]* the currently highlighted entry is loaded from the card and used by the instrument. Transmission line selection can be aborted by pressing [ENTRY OFF], in which case the transmission line that was last selected will continue to be used. Note that only the first 20 characters of the manufacturers' names will be displayed.

Select Subset — Leads to the Select Subset Menu.
See page 3-144.

View Data — Used to display all the data for the currently highlighted transmission line.
This soft key is unselectable if no transmission lines are listed.

⇑ — Highlights the previous entry in the list.

⇓ — Highlights the next entry in the list.

Page Up — Displays the previous page of entries in the list.

Page Down — Displays the next page of entries in the list.

Select — Selects the highlighted transmission line and returns to the Access Dbase Menu.
This soft key will be unselectable if no transmission lines are listed.

Select Subset

See Fig. 3-45. **This menu allows a subset of all the transmission lines present on the card to be listed. It is possible to select a subset by manufacturer, medium (waveguide or coax) or by transmission line name, or any combination of the three.**

A form is displayed which lists the three subset selection criteria. One of these can be made the active parameter by using the *[⇑]* and *[⇓]* soft keys. The other soft keys provide various ways of altering the active subset selection criteria.

Any

For a given subset selection criteria all values will be displayed.

Waveguide

Sets the medium to Waveguide.
This soft key is only selectable if the currently selected subset selection criteria is Medium.

Coax

Sets the medium to Coax.
This soft key is only selectable if the currently selected subset selection criteria is Medium.

Text

Allows text entry for the currently selected subset selection criteria. The method of entry is the same as for the Screen Title Menu (page 3-276).

The text entry form can be used to enter either manufacturer or transmission line names. If the last character is a '*' then it is used as a wildcard, e.g. 'Abc*' will select all names beginning with 'abc'. Case is ignored when selecting.

The current manufacturer/transmission line name from the subset selection criteria is displayed on entry to this form; 'any' is shown as '*'.

This soft key is unselectable if the currently selected subset selection criteria is Medium.

Menu

Leads to the Menu menu, which allows entry of subset selection criteria by selecting items from a menu.
This soft key is unselectable if the currently selected subset selection criteria is Medium.
See page 3-145.

⇑

Used to change the currently selected parameter for subset selection criteria.

⇓

Used to change the currently selected parameter for subset selection criteria.

Search

Applies the new subset selection criteria and returns to the Sel from Card Menu.

Menu

See Fig. 3-45. **This menu allows manufacturer or transmission line names to be selected from an alphabetically arranged list.**

The *[⇑]*, *[⇓]*, *[Page Up]* and *[Page Down]* soft keys are used to highlight the required name; on pressing *[Select]* the currently highlighted name is selected.

⇑	Highlights the previous entry in the list
⇓	Highlights the next entry in the list
Page Up	Displays the previous page of entries in the list.
Page Down	Displays the next page of entries in the list.
Select	Selects the highlighted entry and returns to Select Subset Menu.

Cpy from Card

See Fig. 3-45. **This menu enables a transmission line to be selected from the card and copied to a transmission line database store.**

A form is displayed similar to that of the Sel from Card Menu (page 3-143), but also includes information about the store that is to be written to.

Select Subset

Leads to the Select Subset Menu.
See page 3-144.

View Data

Used to display all the data for the currently highlighted transmission line.
This soft key is unselectable if no transmission lines are listed.

⇑

Highlights the previous entry in the list.

⇓

Highlights the next entry in the list.

Page Up

Displays the previous page of entries in the list.

Page Down

Displays the next page of entries in the list.

Select Store

Used to select the store to copy to by entering the required store identity number.

Copy

Copies the data for the highlighted transmission line to the specified transmission line database store, and returns to the Access Dbase Menu.
This soft key will be unselectable if no transmission lines are listed.

Edit Store

See Fig. 3-46. **This menu allows data to be entered for transmission lines not provided on the memory card. A form is displayed giving the data contained in the selected transmission line database store.**

Select Store
Used to select one of the five transmission line database stores to be edited, by entering the required store identity number.

Edit Manufacturer
A text entry form is provided to allow editing of the manufacturer name. The method of entry is the same as for the Screen Title Menu (page 3-276).

Edit Tx Line
A text entry form is provided to allow editing of the transmission line name. The method of entry is the same as for the Screen Title Menu (page 3-276).

Edit Medium
Leads to the Edit Medium Menu.
See page 3-148.

Edit Cutoff Frequency
Allows the value for waveguide cutoff frequency to be edited.
This soft key is unselectable if the medium is coax.

Edit Relative Velocity
Allows the value for relative velocity to be edited.
This soft key is unselectable if the medium is waveguide.

Edit Atten Table
Leads to the Edit Attn Table Menu.
See page 3-149.

Save Store
Writes the data back to the transmission line database store, and returns to the Access Dbase menu.
This soft key will be unselectable if any of the data is invalid.

Edit Medium — *See Fig. 3-46.* **This menu allows the transmission line medium to be specified.**

Waveguide	Sets the medium to waveguide.
Coax	Sets the medium to coax.
Return to Edit Store	Returns control to the Edit Store Menu.

Edit Attn Table

See Fig. 3-46. **This menu allows the attenuation table for the transmission line to be edited. This table specifies the attenuation values for the transmission line at various frequencies; the table can contain a maximum of twenty entries.**

Entries can be added to or deleted from the table, or existing entries changed. Frequencies cannot be edited, therefore if a new entry at a different frequency is to be added, the existing entry must be deleted and a new entry with the desired frequency added.

The *[⇑]* and *[⇓]* soft keys are used to highlight the entry to be edited or deleted.

Edit Entry

Allows the attenuation value for the highlighted entry to be edited. The *[⇑]* and *[⇓]* soft keys are still available for selecting the required entry.
This soft key is unselectable if the table is empty.

Add Entry

Allows additional entries to be added to the attenuation table. A form is displayed for the entry of the frequency and attenuation values. The *[⇐]* and *[⇒]* soft keys are used to select the parameter to be entered. The *[Add Entry]* soft key adds the entry into the table, and sorts the entries into frequency order.
This soft key is unselectable if the table is full.

Delete Entry

Deletes the highlighted entry from the table.

⇑

Highlights the previous entry in the table.

⇓

Highlights the next entry in the table.

Return to Edit Store

Returns control to the Edit Store Menu.

Set Params

See Fig. 3-45. **This menu is used to manually set the parameters for the transmission line, rather than using the transmission line database.**

Set Cutoff Frequency

The cutoff frequency is the frequency below which propagation ceases in the waveguide. This parameter is required in order that the MTS can generate the non-linear frequency sweep that is required for waveguide measurements.
This soft key will only be selectable if the transmission line medium is waveguide (Config F Loc Menu, page 3-137)

Rotary Control √	Step Keys √	Numeric Pad √	Terminator 10+

Set Relative Velocity

The relative velocity represents the speed of propagation through the transmission medium as a fraction of the speed of light in free space range (0 to 1). If the line consists of more than one section, and the relative velocities are significantly different, an 'average' value can be calculated for the composite line. The individual figures for relative velocity should be weighted to take account of the relative lengths of the sections, i.e. the longer the section, the greater the effect it has on the composite figure. The relative velocity is 1 for most waveguides.
This soft key will only be selectable if the transmission line medium is coax (Config F Loc Menu, page 3-137).

Rotary Control √	Step Keys √	Numeric Pad √	Terminator Any

Set Attenuation

This parameter is the attenuation characteristic of the transmission medium in dB/m or dB/ft, depending on the distance units that have been selected. If the line consists of more than one section, and the attenuation figures are significantly different, an 'average' value can be calculated for the composite line. The individual figures for attenuation should be weighted to take account of the relative lengths of the sections, i.e. the longer the section, the greater the effect it has on the composite figure.

Rotary Control √	Step Keys √	Numeric Pad √	Terminator Any

Return to Set Up Meas

Returns control to the Set Up Meas Menu.

F Loc Funcs *See Fig. 3-43*

Windowing Low

Sets the level of windowing to be applied to the acquired data in the fault location measurement to low. Data windowing reduces the amplitudes of the sidelobes associated with the main peak on the display, but gives reduced distance resolution. Variation of the windowing level provides a trade-off between distance resolution and the height of the sidelobes. A low windowing level gives greater distance resolution but higher sidelobes.

Fig. 3-40 shows the effect on the display of two data windowing levels.

Windowing Medium

Sets the level of windowing to be applied to the acquired data in the fault location measurement to medium. A medium windowing level gives an optimum trade-off between distance resolution and sidelobe height for most applications. This is the default setting for the instruments.

Windowing High

Sets the level of windowing to be applied to the acquired data in the fault location measurement to high. A high windowing level gives reduced sidelobe height but with some loss of distance resolution.

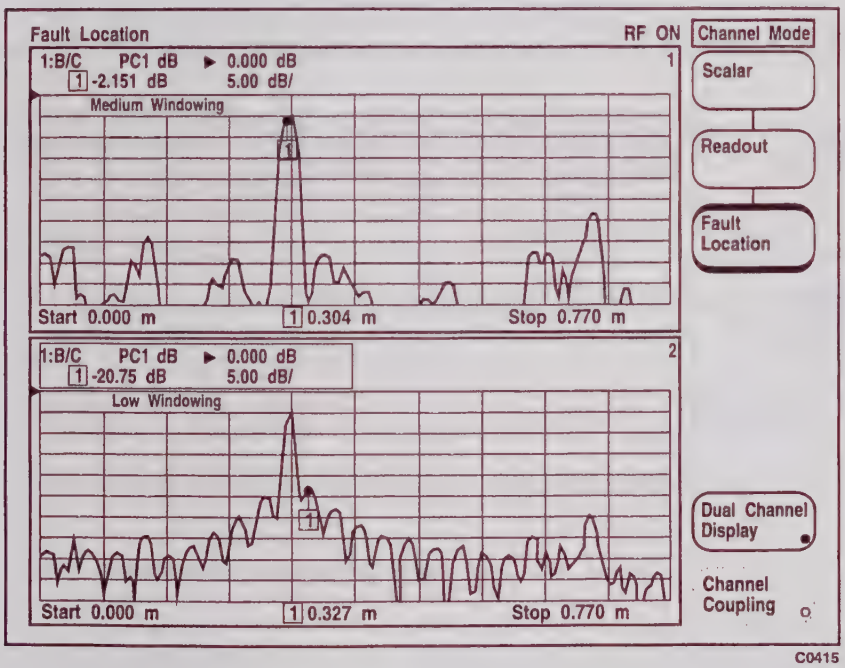

Fig. 3-40 Effect of Data Windowing on a Fault Location Measurement

Enhanced Mode

Leads to the Enhance Mode Menu, which enables a part of the display range to be magnified by changing the start and stop values.
See page 3-153.

Masking Correction

Toggles masking correction on or off. This feature corrects for amplitude errors caused by preceding peaks in the fault location measurement. Refer to Fig. 3-41 for an example of the effect of masking correction.

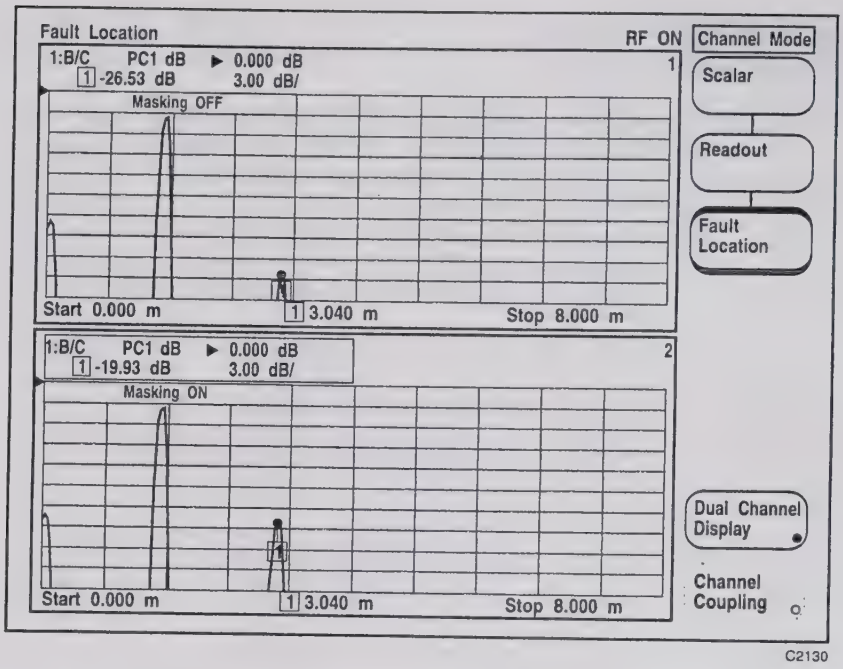

Fig. 3-41 Effect of Masking Correction on a Fault Location Measurement

Limit Checking

Leads to the Lim Checking Menu, which enables the displayed trace to be compared with user-defined limits. This is the same as for a scalar channel, except that the bottom soft key returns control to the F Loc Funcs Menu, not the Measure Menu.
This soft key is only selectable if Measurement 1 is active.
See page 3-56.

Return to Measure

Returns control to the Measure Menu.

Enhance Mode

See Fig. 3-43 **Following calibration, the horizontal axis will display distance from zero to the range specified in the Set Up Meas Menu. This menu enables the user to specify a sub-range of displayed distance values by entering the required start and stop values, or by specifying centre and span values. This effectively provides a magnification facility for a selected part of the range. Note that the frequency sweep of the source remains constant; the magnification is accomplished by processing the measurement results.**

The display start and stop values can also be set to the distances corresponding to the position of the active marker on the active measurement. This is done by pressing the appropriate soft key, positioning the active marker on the trace, then pressing the [×1] key on the numeric keypad.

If the centre & span mode has been selected, the centre value is set by pressing *[Set Display Cntr]*, positioning the active marker, then pressing the [×1] key on the numeric keypad. The span is set by pressing *[Set Display Span]*, positioning the delta marker to the appropriate point either side of the centre, then pressing the [×1] key. (If necessary, enable the delta marker from the Marker Menu.)

If the measurement range is subsequently altered while in this mode, then after re-calibration the display will show the new measurement range, rather than the sub-range.

Set Display Start

If the start/stop mode has been selected, this soft key is used to change the start value of the displayed distance. In the centre/span mode this soft key is labelled *[Set Display Cntr]*, and is used to change the centre value of the displayed range.

Rotary Control √	Step Keys √	Numeric Pad √	Terminator 10+

Set Display Stop

If the start/stop mode has been selected, this soft key is used to change the stop value of the displayed distance. In the centre/span mode this soft key is labelled *[Set Display Span]*, and is used to change the span of the displayed range.

Rotary Control √	Step Keys √	Numeric Pad √	Terminator 10+

Display as Start & Stop

Displays distance as values between the start and stop values as defined above.

Display as Cntr & Span

Displays distance as a centre value and span.

Enhanced Mode

Toggles the Enhanced Mode on or off. Enhanced mode gives an optimally interpolated display trace resulting in improved distance and amplitude accuracy, particularly when displaying a sub-range of the distance scale . However, when the Enhanced Mode is turned on, the measurement time is significantly increased. Fig. 3-42 shows the effect of this mode when displaying a sub-range of a measurement.

Return to F Loc Funcs

Returns control to the F Loc Funcs Menu.

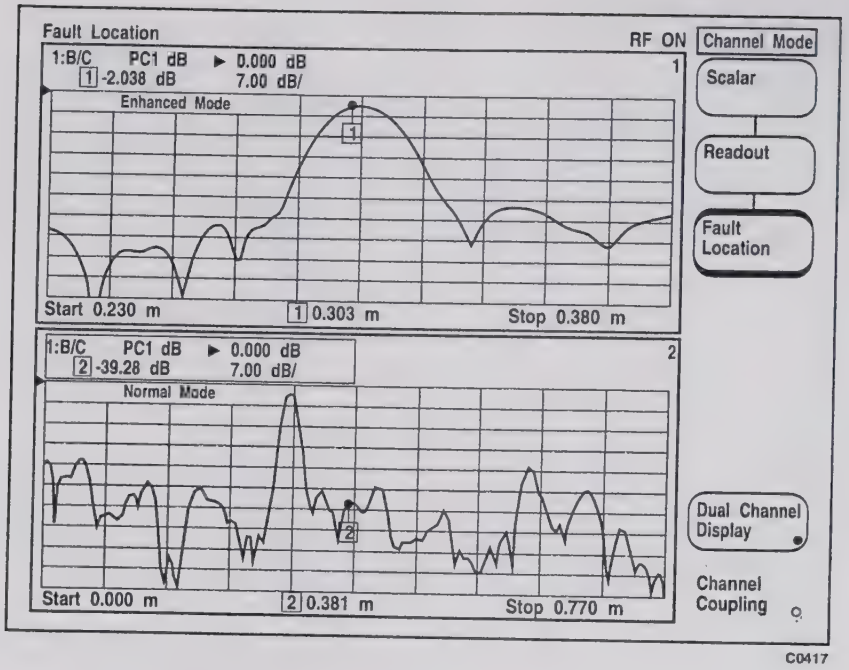

Fig. 3-42 Effect of Enhanced Mode on a Fault Location Measurement

Fig. 3-43 MEASURE Menus - Fault Location Channel (Sheet 1)

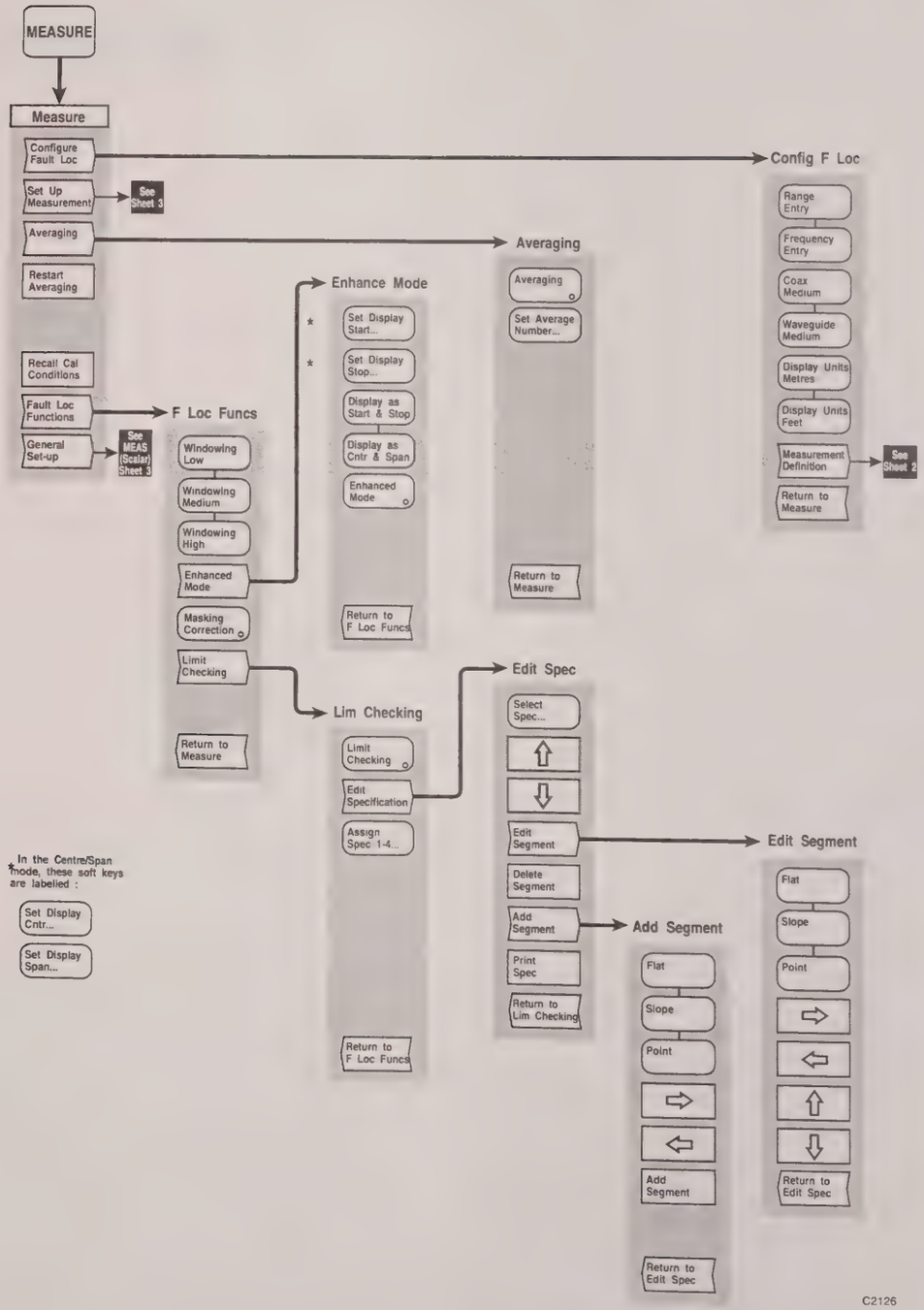

Fig. 3-43 MEASURE Menus - Fault Location Channel (Sheet 1)

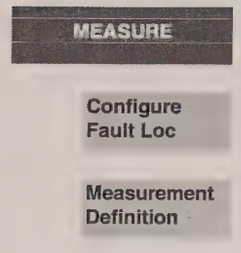

Fig. 3-44 MEASURE Menus - Fault Location Channel (Sheet 2)

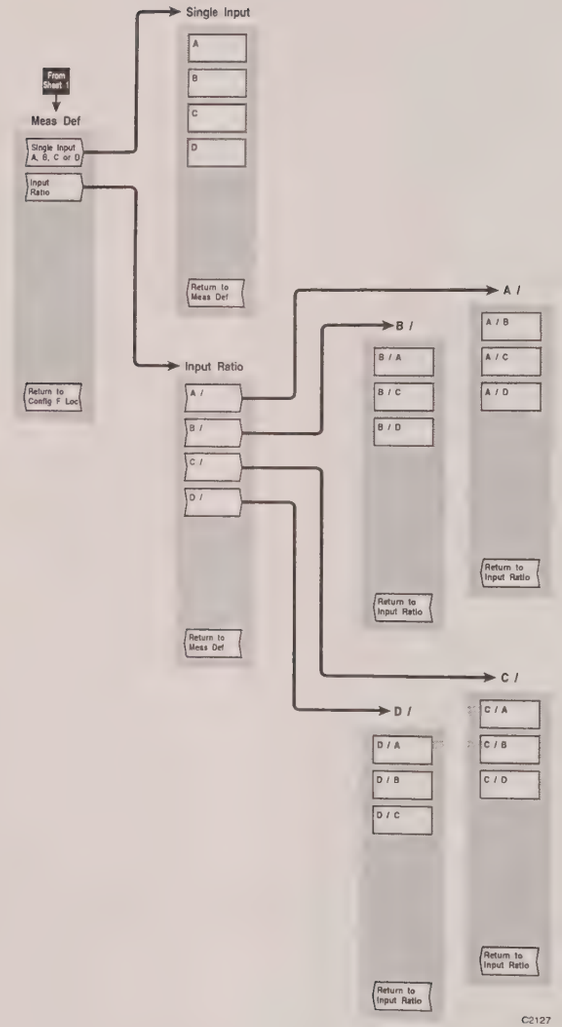

Fig. 3-44 MEASURE Menus - Fault Location Channel (Sheet 2)

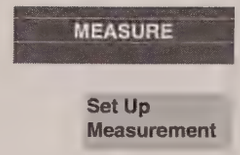

Fig. 3-45 MEASURE Menus - Fault Location Channel (Sheet 3)

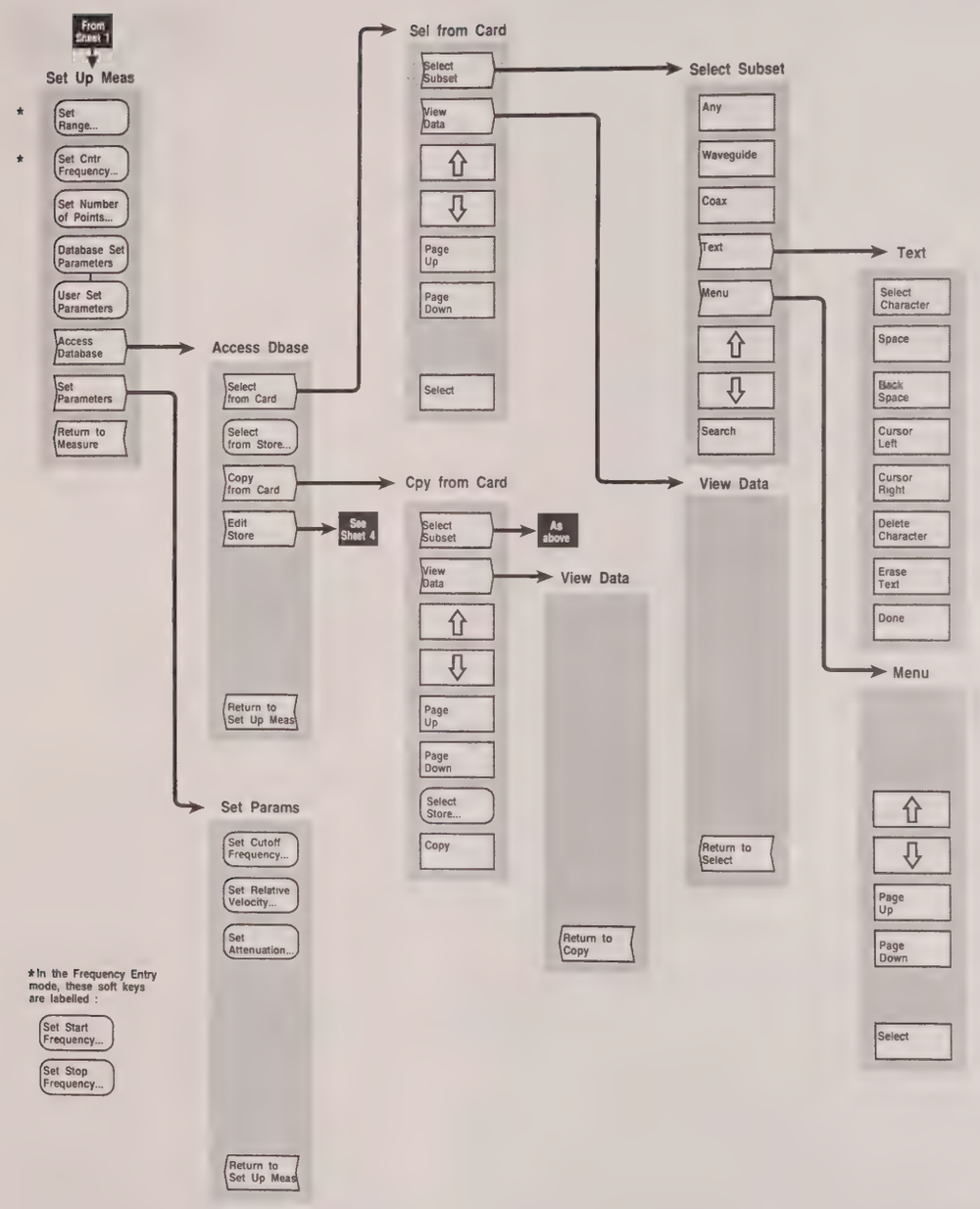

Fig. 3-45 MEASURE Menus - Fault Location Channel (Sheet 3)

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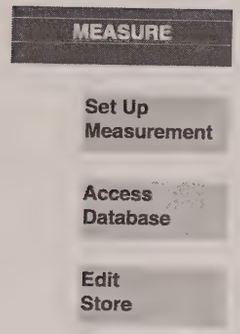


Fig. 3-46 MEASURE Menus - Fault Location Channel (Sheet 4)

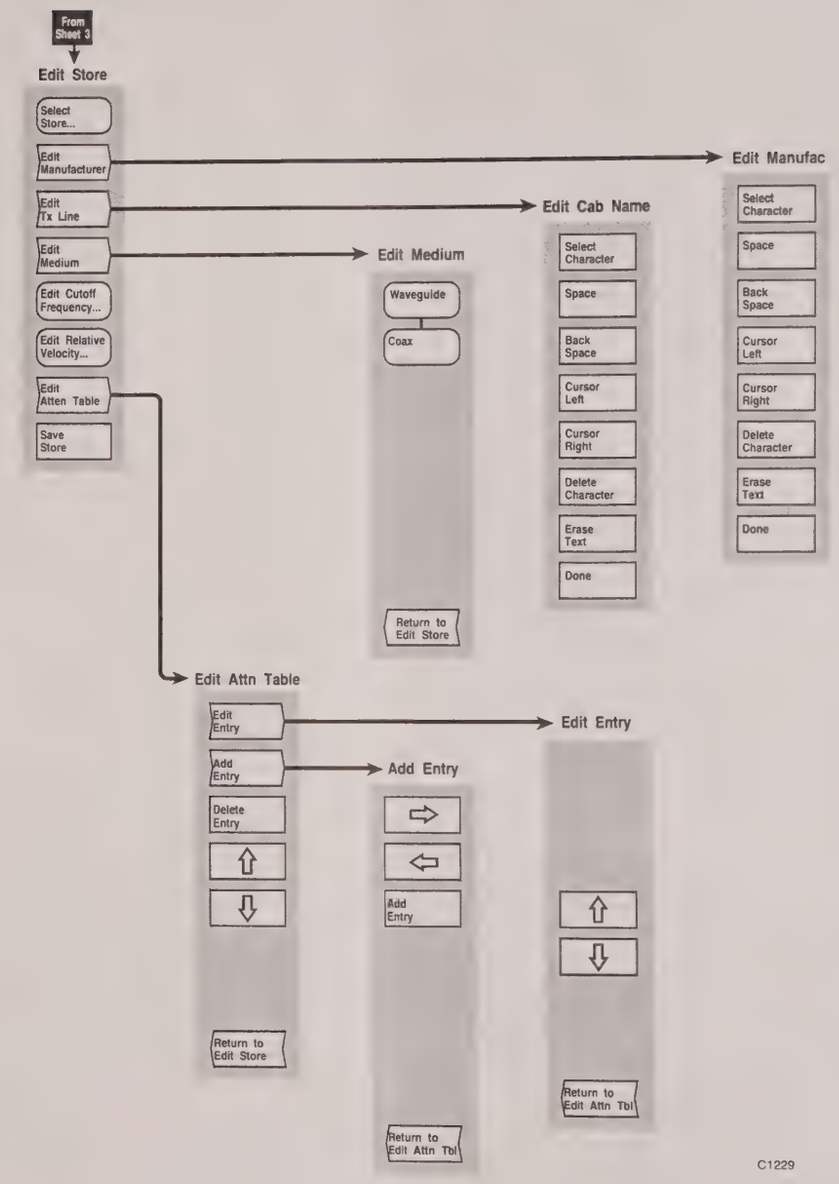


Fig. 3-46 MEASURE Menus - Fault Location Channel (Sheet 4)

[CAL] KEY

The [CAL] key provides access to the menu shown in Fig. 3-47, which is used for calibrating the measurement system prior to a measurement in order to remove system errors that cause uncertainty in measuring a device under test. Facilities are also provided for detector/sensor zeroing and sensor calibration.

Cal

Fault Location Cal

When this soft key is pressed, the user is prompted to connect a matched load to the FAULT LOCATION test port of a Test Head and press the *[Continue]* soft key when ready. A detector zero is automatically performed, followed by calibration of the measurement system. The user is informed when calibration data has been acquired and path calibration has been applied. The calibration data is stored in the default path cal store associated with trace 1 of the fault location channel. The function then terminates and the user is returned to the initial Cal Menu.

The *[Abort Calibration]* soft key is used to terminate the calibration process at any time. The current path cal store will not be affected.

Det/Sensor Zero

Leads to the Det/Sen Zero Menu, which is used for zeroing detectors/sensors.
See page 3-87.

Sensor Cal

Leads to the Sensor Cal Menu, which is used to zero the power sensor and to calibrate it against the reference.
This soft key will only be selectable if Input D is configured for a power sensor.
See page 3-88

Power Ref

Toggles the power reference output on and off. The reference can be used, for example, to verify that the power sensor is functioning correctly. The Power Reference On indicator (PWRREF) will be present in the General Information Area at the top of the screen if a power reference signal is being output.

Fig. 3-47 CAL Menu - Fault Location Channel

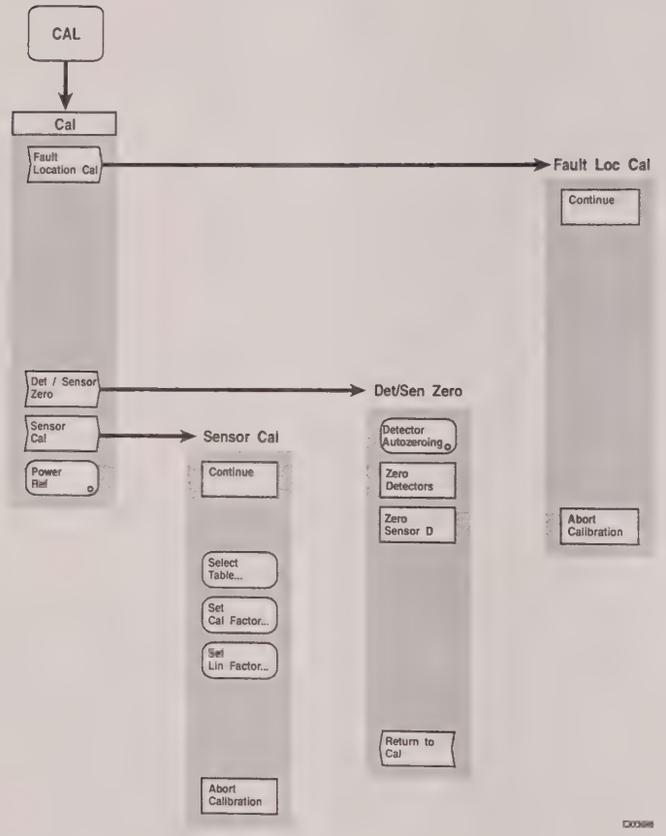


Fig. 3-47 CAL Menu - Fault Location Channel

[FORMAT] KEY

The [FORMAT] key enables the fault location measurement to be displayed in the required format.

Fig. 3-48 FORMAT Menu - Fault Location Channel

FORMAT

Format — **The two soft keys in this menu enable the measurement to displayed in dB or VSWR format.**

dB — Selects dB format.

VSWR — Selects VSWR format.

[SCALING] KEY

The [SCALING] key provides a menu which enables the user to adjust the positioning and scaling of the fault location trace, or to allow the instrument to set the scaling automatically.

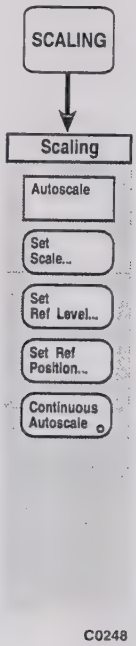


Fig. 3-49 SCALING Menu - Fault Location Channel

Scaling

This menu enables the user to set the reference level and scaling for a trace. The reference position is the position on the vertical axis that remains fixed during scaling. This is indicated on the screen by the Reference Position Indicator (see the 'Display' Section). The reference level is the value corresponding to the position of the Reference Position Indicator on the vertical scale, and is displayed in the relevant trace information area.

The default values for reference level and scaling factor for both types of format are given below. The default reference position for dB format is the top graticule line. For VSWR format the reference position is the bottom graticule line.

Format	Reference Level	Scale Factor
dB	+20.0	10.0 dB(m)/div
VSWR	1.0	0.1 /div

Autoscale

Allows the instrument to determine optimum values of scale and reference level. The value chosen for the scale factor will be selected from a 1,2,5 sequence. The value chosen for the reference level will be a multiple of the scaling factor. The reference position will remain unchanged.

For a Fault location channel, automatic baseline clipping is used to eliminate noise and emphasize peaks. The algorithm used selects the reference level such that the positive peaks of the measurement are not clipped by the top graticule line; the scale factor is selected such that 10% of the measurement points are visible above the bottom graticule line, the remaining 90% being clipped.

Set Scale

Used to set the scale factor for a trace.

dB/dBm Format

Rotary Control √	Step Keys √	Numeric Pad √	Terminator Any

VSWR Format

Rotary Control √	Step Keys √	Numeric Pad √	Terminator 10⁻

Set Ref Level

Used to set the reference level for a trace.

Numeric entry as above.

The reference level can also be set to he response measured at the active marker position, by pressing this soft key followed by the [×1] key on the numeric keypad.

Set Ref Position

Used to set the reference position for a trace. The reference position may be placed on any of the 11 horizontal lines on the graticule.

Rotary Control √	Step Keys √	Numeric Pad ×	Terminator ×

Continuous Autoscale

Toggles continuous autoscale on or off, in which autoscaling will be performed automatically once per measurement update.

[MARKERS] KEY

The MTS can display up to eight markers per trace, with each marker identified by a number. Any one of these can be designated the active marker, indicated by a box around the number to distinguish it from the normal markers. The active marker can be moved along the x-axis using the step keys, rotary control or by keyboard entry. The step keys and keyboard entry are only available through the Position Active Mkr and Position Delta Mkr functions of the Markers Menu. The rotary control can be used to move the active marker at any time whilst it is displayed, provided that no other from of numeric entry is active. The distance value (x-axis position) of the active marker is displayed below the graticule, and the measured response at this position is displayed in the relevant trace information area.

The delta marker mode provides an additional marker, designated the delta marker, and is represented by Δ on the display. In this mode, the distance value of the active marker is relative to the delta marker position. The measured response is relative to the response at the delta marker position, i.e.

Distance value = Active Marker position – Delta Marker position
Response = Active Marker response – Delta Marker response

Note that the distance values indicated by the active marker represent the actual distance to a discontinuity, not the round trip distance.

The marker menus are shown in Fig. 3-50.

A tracking facility is available for the max/min function; this enables the function to be automatically applied at each measurment update (i.e. at the end of each sweep).

Markers

This menu provides soft keys for setting up markers and using them to perform various types of measurement.

Active Mkr

Toggles the active marker on or off. Turning off the active marker also turns off the delta marker.

Place Mkr at Active

Used to place a marker at the active marker position by entering the required marker number from the keyboard.

This soft key will only be selectable if the active marker is turned on.

Position Active Mkr

Used to change the distance value (x-axis position) of the active marker.
This soft key will only be selectable if the active marker is turned on.

Rotary Control √	Step Keys √	Numeric Pad √	Terminator 10+

Delta Mkr

Toggles the delta marker on or off. Turning on the delta marker also turns on the active marker.

Position Delta Mkr

Used to change the position of the delta marker, using the same method as for the active marker.
This soft key will only be selectable if the delta marker is turned on.

All Mkrs Off

Turns off all the markers for the currently active trace.

Mkr Functions

Leads to the Mkr Funcs Menu, which enables various measurement functions to be carried out by means of the active marker and delta marker.
See page 3-172.

Set Up Mkrs

Leads to the Set Up Mkrs Menu, which allows the user to activate and position selected markers.
See page 3-174.

Mkr Funcs

This menu leads to sub-menus for locating the maximum point on a trace, searching for a specified response value and locating multiple peaks on a displayed trace.

Marker to Max Min

Leads to the Max Min Menu.
See page 3-173

dB/Octave dB/Decade

This soft key is unselectable for fault location measurements.

Peak to Peak

This soft key is unselectable for fault location measurements.

Search

Leads to the Search Menu, which is used to locate a response value on the trace.
See page 3-100.

Bandwidth

This soft key is unselectable for fault location measurements.

Find Next Peak

Leads to the Find Next Pk Menu.
See page 3-173.

Return to Markers

Returns control to the Markers Menu.

Max Min — **This menu is used to locate the maximum point on a trace.**

When the tracking facility is turned on, the selected function as applied automatically at the end of each sweep, thus continually updating the maximum measurement.

Active Mkr to Maximum — Moves the active marker to the maximum point on the displayed trace.

Active Mkr to Minimum — *Unselectable.*

Tracking Maximum — Applies tracking to the maximum function.

Tracking Minimum — *Unselectable.*

Tracking Off — Disables tracking.

Return to Markers — Returns control to the Mkr Funcs Menu.

Find Next Pk — **This menu enables the active marker to be placed at peaks in the trace.**

Find Next Peak Right — Positions the active marker at the next peak in the trace to the right of its current position. The peak that the active marker moves to is defined to be the next local maximum visible on the screen to the right of the current active marker position. If a peak cannot be found, the active marker will remain at its current position.

Find Next Peak Left — As above, but the next peak to the left of the current active marker position is located.

Returns to Mkr Funcs — Return control to the Mkr Funcs Menu.

Set Up Mkrs

This menu enables selected markers to be turned on or off and positioned on the display, and allows one of the markers to be selected as the active marker. A soft key is also provided to turn marker coupling between channels on or off.

Assign Active Mkr 1-8

Used to select the marker which will act as the active marker.

Rotary Control	×	Step Keys	×	Numeric Pad	√	Terminator	None

Mkr 1-8 On

Turns a selected marker on by entering the required marker number.

Rotary Control	×	Step Keys	×	Numeric Pad	√	Terminator	None

Mkr 1-8 Off

Turns a selected marker off by entering the required marker number.

Rotary Control	×	Step Keys	×	Numeric Pad	√	Terminator	None

Position Mkr 1-8

Used to change the distance value (x-axis position) of a specified marker. A form is displayed on the screen containing numeric entry fields for the marker number and the marker position. The required marker is first selected, then its position is changed.

Marker Number

Rotary Control	×	Step Keys	×	Numeric Pad	√	Terminator	None

Marker Position

Rotary Control	√	Step Keys	√	Numeric Pad	√	Terminator	10+

This soft key will only be selectable if at least one of the markers is turned on.

6 Digits Resolution

This soft key is unselectable for a fault location channel.

1 Hz Resolution

This soft key is unselectable for a fault location channel.

Mkr Coupling

Toggles marker coupling between channels on or off. When marker coupling is enabled, the positions (i.e. domain or x-axis values) of all markers on all traces will track the positions of the markers on the active trace of the active channel. When marker coupling is disabled, markers may be positioned independently on each channel. The default setting for marker coupling is on.

Marker coupling can only be disabled when channel coupling is switched off (Channel Mode Menu).

Return to Makers

Returns control to the Markers Menu.

Fig. 3-50 MARKERS Menus - Fault Location Channel

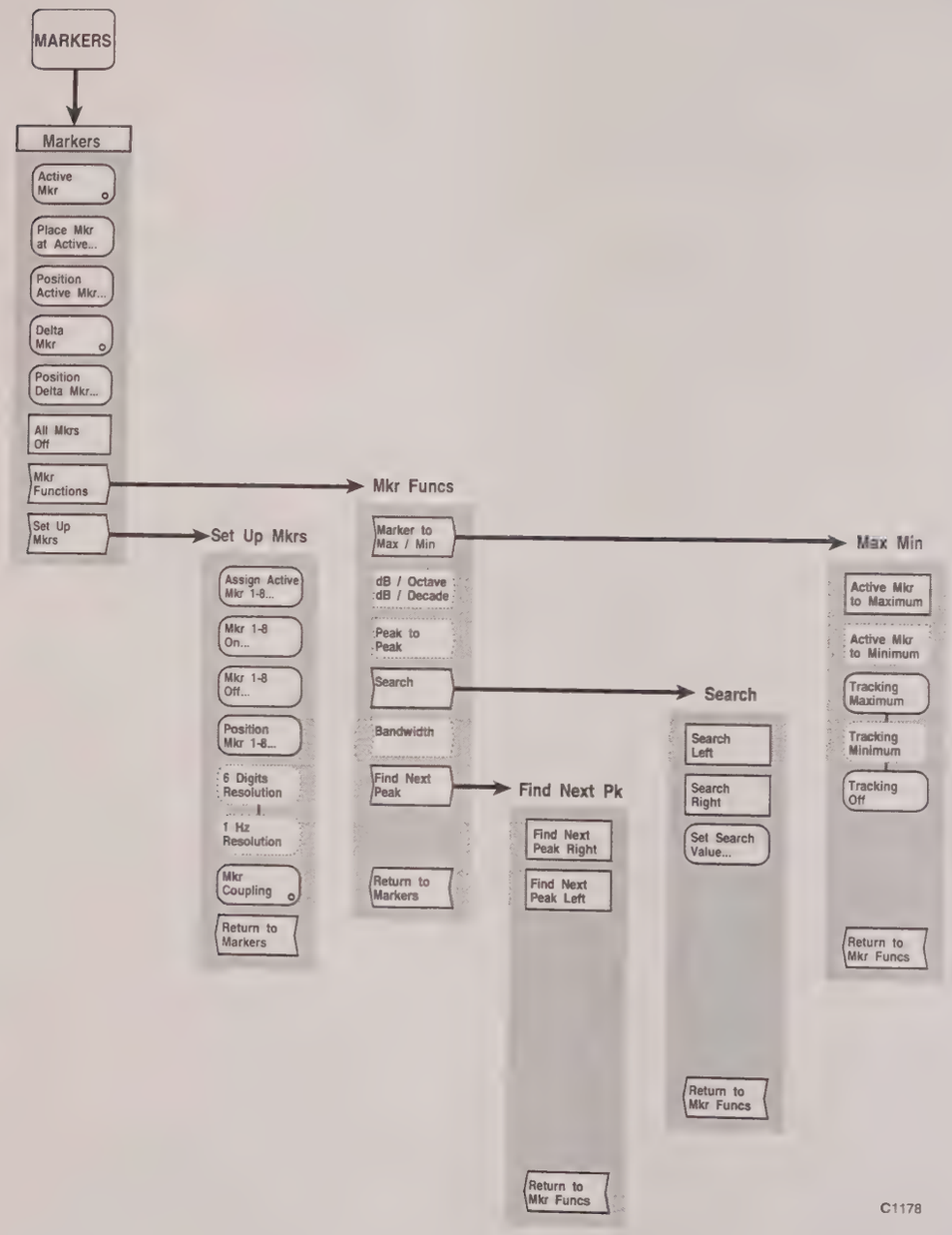


Fig. 3-50 MARKERS Menus - Fault Location Channel

[SOURCE] KEY

The [SOURCE] key provides access to the series of menus illustrated in Figs. 3-52 to 3-54, which are used to define and control all the source functions for a reflection analyzer channel.

The *[Select Source Mode]* soft key is used to access the Source Mode Menu, and the required mode is selected by pressing the appropriate soft key. Pressing *[Return to Source]* will return the user to the source menu corresponding to the selected mode. With the 6210 Reflection Analyzer connected, three additional source modes are available, accessed by pressing the *[More]* soft key in the Source Mode Menu. Pressing *[Return to Prior Menu][Return to Source]* returns the user to the appropriate source menu. There are therefore three extra source menus available for a reflection analyzer channel, one for each of the additional source modes. These are:

Linear List Frequency Sweep (sweep defined as a series of segments).

Waveguide Frequency Sweep (generates a non-linear sweep for waveguide measurements).

Low Pass Frequency Sweep (used when making low pass time domain measurements).

The last four soft keys of the Source Menu are the same for each of the source modes; the remaining four will vary to reflect the parameters required for the particular source mode.

Several of the source menus for a reflection analyzer channel are the same as for a scalar channel, and are fully described in the appropriate section. This section only covers new menus, or those that differ from the corresponding scalar channel menus.

Source (Linear List Frequency Sweep)

See Fig. 3-52. **This menu allows the operator to arbitrarily define the frequency sweep, by specifying up to 12 sweep segments, with each segment consisting of a start and stop frequency and a number of measurement points. This allows measurement points to be concentrated around points of interest during reflection analyzer measurements. The system will keep a running check on the total number of points required, and will not be permitted to exceed the limit for the system (800 points).**

The menu will only be available if the 6210 Reflection Analyzer option is fitted, and if the currently active channel has been designated a reflection analyzer channel.

Set Up List

Leads to the Set Up List Menu, which enables the sweep segments for the linear list sweep to be defined.
See page 3-181.

Set Output Power

Used to change the output power of the source for the currently active channel.

Rotary Control √	Step Keys √	Numeric Pad √	Terminator Any

Sweep Time

Leads to the Sweep Time Menu, which enables the sweep time to be set up manually or automatically.
See page 3-34.

RF

Toggles the RF output on or off.

Select Source Mode

Leads to the Source Mode Menu, which enables CW operation or one of several sweep modes to be selected
See page 3-35

Source Functions

Leads to the Source Funcs Menu, which enables several options to be selected, allowing the source to be set up according to the requirements of a particular measurement.
See page 3-36.

Source (Waveguide Sweep)

See Fig. 3-53. **This menu allows the operator to set up the source for making measurements on a waveguide system, by defining the start and stop frequency values and the waveguide cutoff frequency.**

The menu will only be available if the 6210 Reflection Analyzer is fitted, and if the currently active channel has been designated a reflection analyzer channel.

Set Frequencies

Leads to the Set Freqs Menu.
See page 3-183.

Set Output Power

Used to change the output power of the source for the currently active channel.

Rotary Control √	Step Keys √	Numeric Pad √	Terminator Any

Set Number of Points

Used to change the number of measurement points generated by the sweep for the currently active channel, up to a maximum of 800 points.

Sweep Time

Leads to the Sweep Time Menu, which enables the sweep time to be set up manually or automatically.
See page 3-34.

RF

Toggles the RF output on or off.

Select Source Mode

Leads to the Source Mode Menu, which enables CW operation or one of several sweep modes to be selected
See page 3-35.

Source Functions

Leads to the Source Funcs Menu, which enables several options to be selected, allowing the source to be set up according to the requirements of a particular measurement.
See page 3-36.

Source (Low Pass Sweep)

See Fig. 3-54. **This menu allows the operator to set up the source for making measurements using the Low Pass Time Domain Transform. The menu will only be available if the 6210 Reflection Analyzer is fitted, and if the currently active channel has been designated a reflection analyzer channel..**

In the low pass sweep mode, the frequency data points are harmonically related from DC to the stop frequency. That is, stop frequency = number of points × start frequency. The DC frequency response is extrapolated from the lower frequency data. The time domain functions are more fully described on page 3-197.

Set Stop Frequency

Used to set the stop frequency used in the low pass sweep. On entering a value, the stop frequency will be set to the nearest frequency that can be achieved within the constraints of a low pass sweep, and will always lie between the entered value and the maximum frequency of the instrument. In order to produce a valid low pass sweep with the selected stop frequency, the MTS may need to change the number of sweep points. This figure is indicated on the form that is displayed when this soft key is pressed, and is updated whenever the stop frequency is changed.

Rotary Control √	Step Keys √	Numeric Pad √	Terminator	10+

Set Output Power

Used to change the output power of the source for the currently active channel.

Rotary Control √	Step Keys √	Numeric Pad √	Terminator	Any

Set Number of points

Used to set the number of measurement points generated by the low pass sweep for the currently active channel. The number entered (up to a maximum of 800) will be set to the nearest lower value that satisfies the constraints of the low pass sweep with the existing stop frequency.

Sweep Time

Leads to the Sweep Time Menu, which enables the sweep time to be set up manually or automatically.
See page 3-34.

RF

Toggles the RF output on or off.

Select Source Mode

Leads to the Source Mode Menu, which enables CW operation or one of several sweep modes to be selected
See page 3-35.

Source Functions

Leads to the Source Funcs Menu, which enables several options to be selected, allowing the source to be set up according to the requirements of a particular measurement.
See page 3-36.

Set Up List

See Fig. 3-52. **This menu enables setting up of the sweep segments that define the linear list sweep. In addition to the soft key labels, a form is displayed on the screen showing the current sweep specification in segment order (Fig. 3-51).**

Each segment is defined by the following parameters:

Segment number, start frequency, stop frequency and number of points in the segment

Set Up List

	START FREQ	STOP FREQ	No POINTS
1	250.000000 MHz	20.000000000 GHz	400
2	1.000000000 GHz	2.000000000 GHz	100
3	5.000000000 GHz	8.000000000 GHz	100
4	10.000000000 GHz	12.000000000 GHz	100
5	15.000000000 GHz	17.000000000 GHz	100

Fig. 3-51 Linear List Sweep Specification Form

An existing segment can be selected for editing using the *[⇑]* and *[⇓]* soft keys. A new segment can be added to the end of the list by pressing the *[Add Segment]* soft key, or deleted by selecting it using the *[⇑]* and *[⇓]* soft keys and then pressing the *[Delete Segment]* soft key.

The *[⇐]* and *[⇒]* soft keys are used to move between the fields of the segments when editing. The currently selected field is changed by entering the required value as follows:

Start/stop frequencies

Rotary Control	×	Step Keys	×	Numeric Pad	√	Terminator	10+

Number of points

Rotary Control	×	Step Keys	×	Numeric Pad	√	Terminator	Any

After the value has been entered, the field to the right of the current one becomes the active field.

Add Segment

Used to add a new segment to the end of the list. The start frequency defaults to the stop frequency of the previous segment, and the stop frequency defaults to the maximum available source frequency. The number of points defaults to the remaining number of available points. If all the points have been allocated or there are twelve segments in the list, the *[Add Segment]* soft key will be unselectable.

⇒	Makes the next field in the segment the active field.
⇐	Makes the previous field in the segment the active field.
⇑	Makes the previous segment in the specification the active segment.
⇓	Makes the next segment in the specification the active segment.
Delete Segment	Used to delete a segment from the list, after asking for confirmation. The segments below the deleted one will be moved upwards in the list and renumbered. If there is only one segment in the list the *[Delete Segment]* soft key will be unselectable.
Return to Source	Returns control to the Source Menu.

Set Frequencies

Set Freqs

See Fig. 3-53. **This menu enables the operator to set up the source to provide a non-linear frequency sweep between the entered start and stop frequency values when making waveguide measurements. The MTS generates the required frequencies from a knowledge of the start and stop values and the waveguide cutoff frequency.**

Set Start Frequency

Used to change the start frequency of the source for the currently active channel to a value within the range permitted for the particular MTS.

Rotary Control √	Step Keys √	Numeric Pad √	Terminator	10+

Set Stop Frequency

Similar to the above but applies to the stop frequency of the sweep.

Set Cutoff Frequency

The cutoff frequency is the frequency below which propagation ceases in the waveguide. This parameter is required in order that the MTS can generate the non-linear frequency sweep that is required for waveguide measurements, and applies instrument wide.

Rotary Control √	Step Keys √	Numeric Pad √	Terminator	10+

Return to Source

Returns control to the Source Menu.

Source Mode
(More)

See Fig. 3-52. **This menu extends the options available from the main Source Mode Menu (page 3-35), and enables the MTS source to be set up to provide one of three frequency sweeps when performing reflection analyzer measurements.**

Only one of the following options can be selected at a time; pressing one of the soft keys automatically de-selects the current mode and selects the new one. The parameters of the source for the selected mode can be set up after returning to the Source Menu.

Linear List Freq Sweep — Sets the source to the linear list frequency sweep mode of operation, where the sweep is defined in a series of segments.

Waveguide Sweep — Sets the source to the waveguide sweep mode of operation, which is used to generate the non-linear frequency sweep required for waveguide measurements.

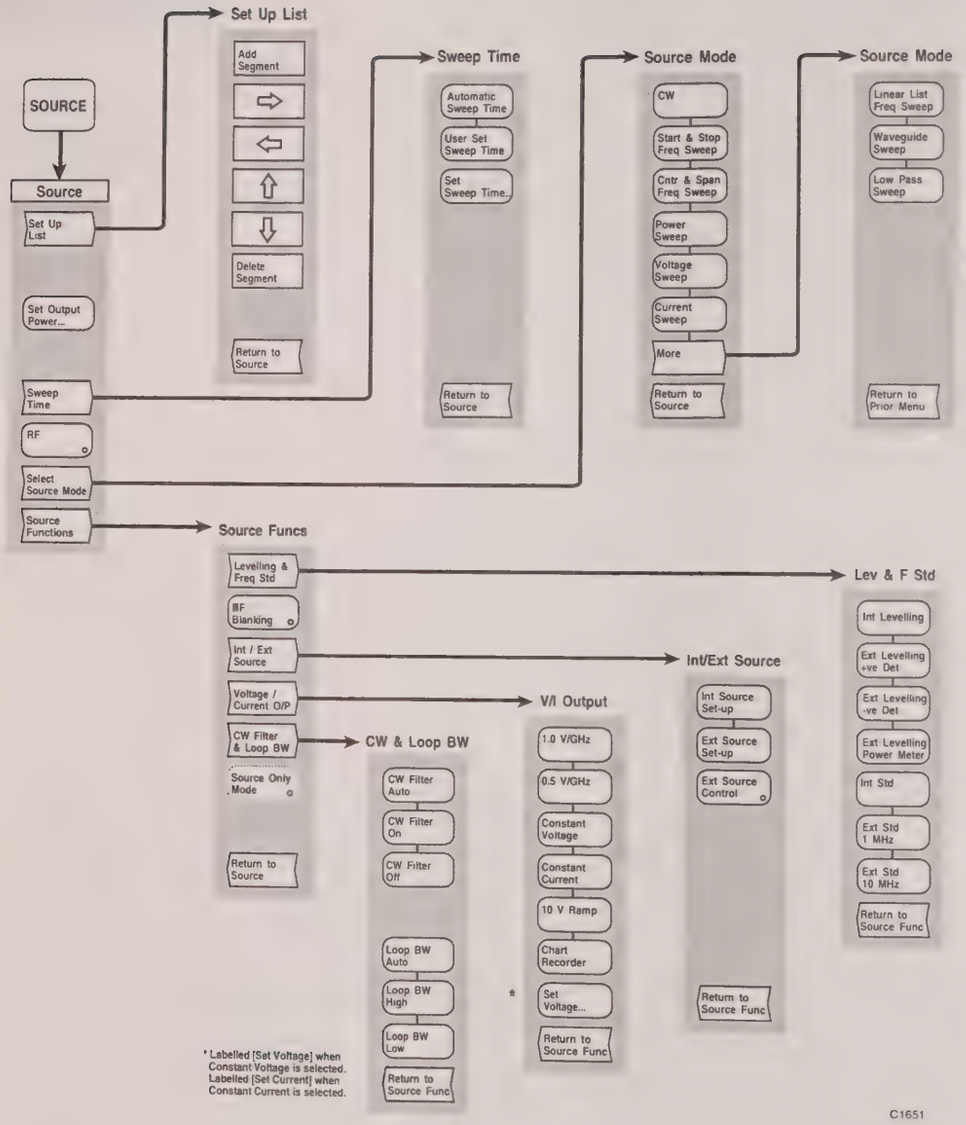
Low Pass Sweep — Sets the source to the low pass sweep mode of operation; this sweep mode must be selected when the Low Pass Transform is to be used.

Return to Prior Menu — Returns control to the Source Mode Menu.

SOURCE

LINEAR LIST
FREQUENCY
SWEEP MODE

Fig. 3-52 SOURCE Menus - Reflection Analyzer Channel (Sheet 1)



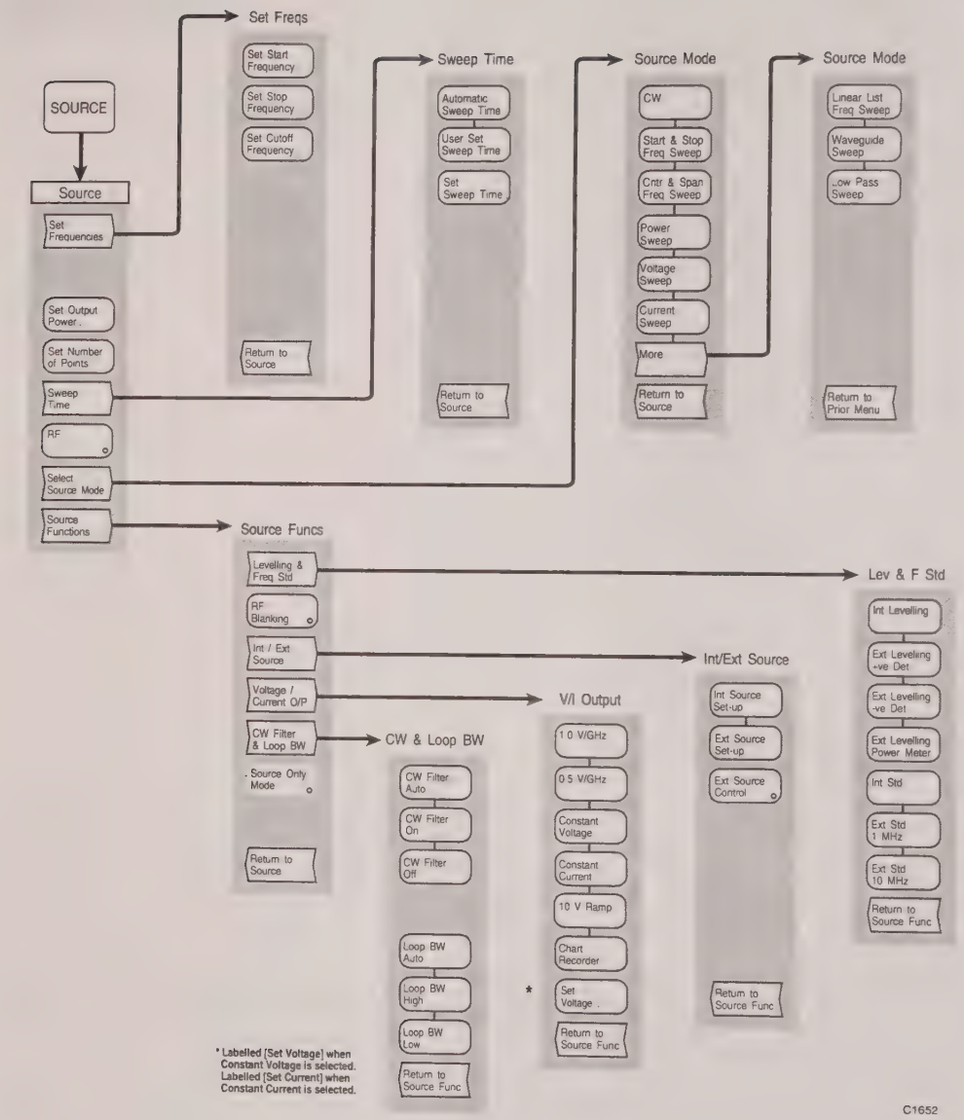
Linear List Frequency Sweep Mode

Fig. 3-52 SOURCE Menus - Reflection Analyzer Channel (Sheet 1)

SOURCE

WAVEGUIDE SWEEP MODE

Fig. 3-53 SOURCE Menus - Reflection Analyzer Channel (Sheet 2)



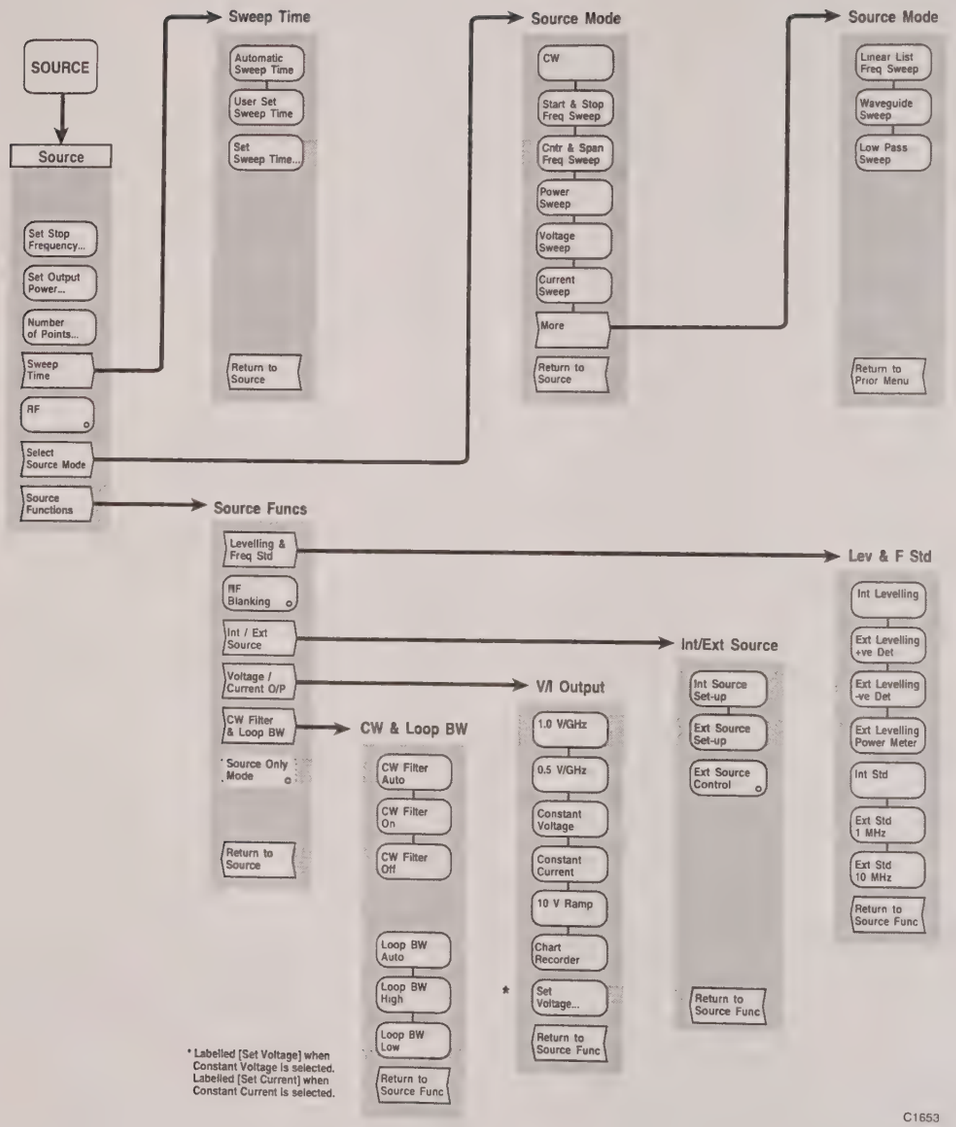
Waveguide Sweep Mode

Fig. 3-53 SOURCE Menus - Reflection Analyzer Channel (Sheet 2)

SOURCE

LOW PASS SWEEP MODE

Fig. 3-54 SOURCE Menus - Reflection Analyzer Channel (Sheet 3)



Low Pass Sweep Mode

Fig. 3-54 SOURCE Menus - Reflection Analyzer Channel (Sheet 3)

[MEASURE] KEY

The [MEASURE] key provides access to the series of menus illustrated in Fig. 3-57, which are used to define and set up the reflection analyzer measurement,

Many of the menus for a reflection analyzer channel are the same as for a scalar channel, and are fully described in the appropriate section. This section only covers new menus, or those that differ from the corresponding scalar channel menus.

Additional information on time domain measurements can be found in Appendix D.

Measure

This menu and its sub-menus are used for setting up the reflection analyzer channel to measure S_{11} and analyzing the results. S_{11} is the S-parameter representing the complex reflection coefficient (magnitude and phase) of the test device input.

S_{11}

If a stored measurement is being displayed, this soft key is used to restore the live measurement of S_{11}.

Time Domain

Used to toggle time domain measurements on or off. Using a mathematical technique (the inverse Fourier transform), frequency domain information is transformed into the time domain, with time as the horizontal display axis. Response values now appear separated in time or distance, as selected by the Display Domain Menu.
This soft key is unselectable if the sweep type is not linear list, low pass or waveguide, or the number of measurement points is less than 40.

Averaging

This function is the same as for a scalar channel.

Restart Averaging

This function is the same as for a scalar channel.

Gating / Fencing

Leads to the Gate/Fence Menu, which provides the facility for selectively removing responses in either frequency or time/distance domains.
This soft key is unselectable if the sweep type is not linear list, low pass or waveguide, or the number of measurement points is less than 40.
See page 3-193.

Time Domain Functions

Leads to the Time Dom Funcs Menu, which provides facilities for displaying measurements in the time (or distance) domain.
This soft key is unselectable if the sweep type is not linear list, low pass or waveguide, or the number of measurement points is less than 40.
See page 3-197.

Display Zoom

Leads to the Display Zoom Menu, which provides a magnification facility.
See page 3-202.

More

Leads to the Measure (More) Menu.
See page 3-203.

Gate/Fence

Gating and fencing are methods by which responses in either the frequency or time/distance domain caused by features of the system under test in areas other than that of interest may be removed from the trace. Gating removes the effects of all features outside the specified range; fencing is the inverse of this and removes the effects of all features within the specified range. The gating/fencing functions applies per measurement.

This feature can be used, for example, to remove the effects if unwanted discontinuities in the time domain; the frequency response of the remaining discontinuities can then be viewed by switching back to the frequency domain. Two channels can be set up to display the time domain and frequency domain responses simultaneously. As adjustments are made in the time domain, the corresponding effect in the frequency domain can be observed in real time.

The start, stop and centre values can also be set to the domain value corresponding to the position of the active marker on the active measurement. This is done by pressing the appropriate soft key, positioning the active marker on the trace, then pressing the [×1] key on the numeric key pad. To set the span, press [Set Gate Span], position the delta marker to the appropriate point on either side of the centre, then press the [×1] key. (If necessary, enable the delta marker from the Markers Menu.)

If gating/fencing is enabled and the display domain is either time or distance for a trace, the gating parameters will be indicated on that trace by a set of three gating markers placed at the start, centre and stop values of the gate. The markers will also indicate whether gating or fencing is being applied. A 'G' flag or 'F' flag will be displayed in the trace information area if gating or fencing are being applied.

See Fig. 3-55 for an example of fencing on a measurement.

Gating / Fencing

This soft key has a toggle action and is used to enable/disable the time domain gating/fencing function for the currently active measurement, without affecting previously set parameters.

Set Gate Start

Used to set the start value of the gating function. The value is entered as either time or distance, according to the domain that has been selected with the Display Domain Menu. If fencing has been selected this soft key is labelled *[Set Fence Start]*, and is used to set the start value of the fencing function.

Time

Rotary Control √	Step Keys √	Numeric Pad √	Terminator	10–

Distance

Rotary Control √	Step Keys √	Numeric Pad √	Terminator	10+

Set Gate Stop

Used to set the stop value of the gating function. The value is entered as either time or distance, according to the domain that has been selected with the Display Domain Menu. If fencing has been selected this soft key is labelled *[Set Fence Stop]*, and is used to set the stop value of the fencing function.

Time

Rotary Control √	Step Keys √	Numeric Pad √	Terminator	10−

Distance

Rotary Control √	Step Keys √	Numeric Pad √	Terminator	10+

Set Gate Cntr

Used to set the centre value of the gating function. The value is entered as either time or distance, according to the domain that has been selected with the Display Domain Menu. If fencing has been selected this soft key is labelled *[Set Fence Cntr]*, and is used to set the centre value of the fencing function.

Time

Rotary Control √	Step Keys √	Numeric Pad √	Terminator	10−

Distance

Rotary Control √	Step Keys √	Numeric Pad √	Terminator	10+

Set Gate Span

Used to set the span value of the gating function. The value is entered as either time or distance, according to the domain that has been selected with the Display Domain Menu. If fencing has been selected this soft key is labelled *[Set Fence Span]*, and is used to set the span value of the fencing function.

Time

Rotary Control √	Step Keys √	Numeric Pad √	Terminator	10−

Distance

Rotary Control √	Step Keys √	Numeric Pad √	Terminator	10+

Gating Mode

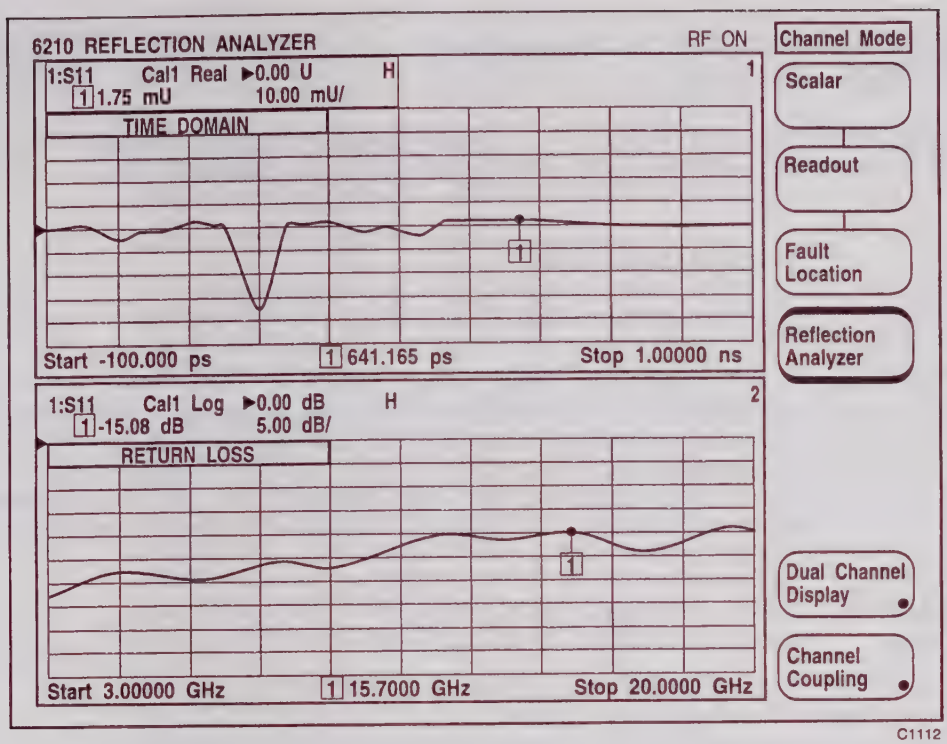
Leads to the Gating Mode Menu.
See page 3-196.

Gate / Fence Shape

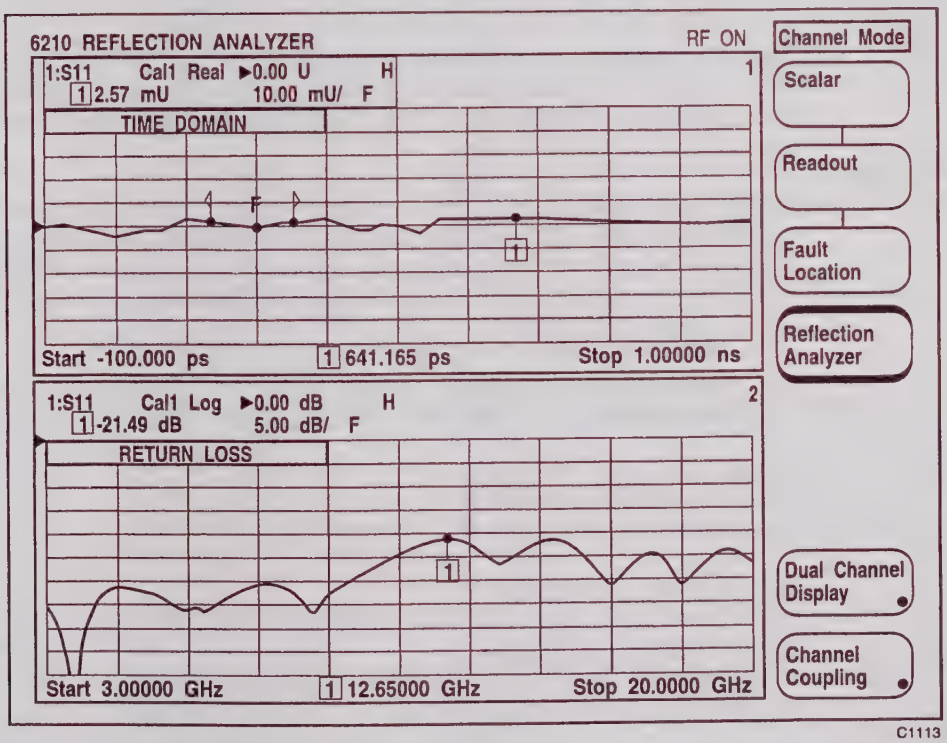
Leads to the G/F Shape Menu.
See page 3-196.

Return to Measure

Returns control to the Measure Menu.



Normal Response



Response with Fencing Applied

Fig. 3-55 Effect of Fencing on a Measurement

Gating Mode

This menu is used to select whether gating or fencing is to be applied to the active measurement, and provides a gate/fence coupling function.

Gating — Selects the gating function.

Fencing — Selects the fencing function

Gate / Fence Coupling — Enables gating/fencing parameters to be coupled across measurements and channels. The parameters that can be coupled are start/stop (centre/span), gate type and gate shape. The enable/disable function, however, will remain independent for each measurement. When gate coupling is on, the gating parameters for the active measurement will be copied to all other measurement setups. If any of the parameters for any of the measurements are subsequently updated while coupling is on, the other measurement setups will also be updated.

Return to Gate / Fence — Returns control to the Gate/Fence Menu.

G / F Shape

This menu allows the user to select the shape of the gate that will be applied to the measurement. The shape affects the degree to which information from one feature in the time (distance) domain can be filtered out without affecting the information obtained from a nearby feature.

The gate can be considered as a bandpass filter in the time (or distance) domain, with the start and stop times as the -6 dB cutoff points. The shape of the gate is determined by the cutoff time, which is the time between the -6 dB cutoff point and the peak of the first sidelobe. Four gate shapes are available, each having different cutoff times, sidelobe levels and passband ripple.

If the gate is set to minimum, this gives the minimum cutoff times but the highest sidelobe levels and passband ripple. The converse is true if it is set to maximum.

Minimum — Sets the gate shape to Minimum.

Normal — Sets the gate shape to Normal.

Wide — Sets the gate shape to Wide.

Maximum — Sets the gate shape to Maximum.

Return to Gate / Fence — Returns control to the Gate/Fence Menu.

Time Dom Funcs

This menu enables the user to select one of two transform types that are available, and to display the response to two different types of stimulus. A windowing facility is also provided to aid interpretation of the displayed measurements.

Two types of time domain transform are available.

The band pass mode is used to characterise band-limited devices, by simulating the time domain response to an impulse input. The horizontal axis represents the time taken for an impulse launched at the test port to reach a discontinuity. This can be expressed as either time or distance, as selected with the Display Domain menu.

The band pass transform simply uses the frequency domain data as it is measured. This gives rise to time domain data with an imaginary component and, in addition, it is not possible to calculate the step response to a system with this type of transform.

The low pass transform is used to simulate a traditional time domain reflectometry measurement. It can display the time domain response to either a step or impulse input, which provides information to determine the type of discontinuities (resistive, capacitive or inductive) that are present. As for the band pass mode, the horizontal axis represents the travel time to the discontinuity, expressed as either time or distance.

With the low pass transform, the frequency data passed into the transform is extrapolated down to DC and assumed to be symmetrical about 0 Hz. This has the advantage that the symmetry of the frequency domain data produces time domain data with no imaginary component. A sub-menu provides functions to control the way in which the extrapolation to DC is performed.

The low pass mode is not as easy to use as band pass, because of the constraints placed on the parameters of a low pass sweep (see the Source Menu for a low pass sweep).

The transform type and response type apply per channel. The default state is band pass transform/impulse response.

Band Pass Transform

Used to transform band-limited frequency domain data into the time domain, with time (or distance) displayed on the horizontal axis. This mode will automatically be selected if the sweep type is Linear List or Waveguide when entering the time domain.

Low Pass Transform

Used to transform low pass frequency domain data into the time domain, with time (or distance) displayed on the horizontal axis.
This soft key is only selectable if the sweep type is Low Pass.

Impulse Response

Used to display the response of the system under test to a simulated impulse input.

Step Response

Used to display the response of the system under test to a simulated step input.
This soft key is only selectable if the Low Pass time domain transform has been selected.

DC Extrapolation

Leads to the DC Extrap Menu, which is used to select the DC extrapolation mode for the measurement.
This soft key is only selectable if the Low Pass time domain transform has been selected.
See page 3-198.

Windowing

Leads to the Windowing Menu, which is used to apply windowing to the frequency domain data.
See page 3-199.

Display Domain

Leads to the Display Domain Menu.
See page 3-201.

Return to Measure

Returns control to the Meas Funcs Menu.

MEASURE | **Time Domain Functions** | **DC Extrapolation**

DC Extrap

This menu is used to control the way in which the extrapolation to DC is performed during a low pass transform. This function applies per measurement.

Automatic

Sets the DC extrapolation mode to automatic, where the DC reflection coefficient is calculated by extrapolating the existing data.

Matched

Used to set the DC reflection to zero.

User Set

Sets the DC extrapolation mode to manual; the following soft key can then be pressed to enable the DC reflection coefficient to be set by the operator.

Set DC Refl Coeff

Allows the DC reflection coefficient to be entered.
This soft key is only selectable if manual mode has been selected, using the [User Set] soft key.

Rotary Control √	Step Keys √	Numeric Pad √	Terminator Any

Return to T Dom Funcs

Returns control to the Time Dom Funcs Menu.

Windowing

This menu is used to determine the degree to which the frequency domain data is filtered prior to conversion to the time domain. The purpose of windowing is to reduce the side lobes created by the transformation process so that the time domain response is easier to interpret when attempting to isolate and identify individual responses.

Windowing is needed because of the abrupt transitions in a frequency domain measurement at the start and stop frequencies. This band limiting causes ringing and overshoot in the time domain response, resulting in sidelobes being displayed either side of an impulse response, which can hide lower level responses.

In order to reduce the sidelobes, the low frequency and high frequency data are attenuated before being passed into the time domain transformation. Thus features affecting the frequencies that are attenuated to a high degree are not seen in the transformed data. In order to compensate for this various window shapes are available, which provide a trade-off between the degree to which they eliminate sidelobes and the range and degree of attenuation that is applied to the extreme frequencies of the sweep. Fig. 3-56 shows the effect on the display of two different window shapes.

This function applies per measurement.

Minimum (Order 0)

Provides essentially no window, and therefore results in the highest sidelobes.

Normal (Order 6)

Gives an optimum trade-off between reduced sidelobes and the attenuation of the extreme frequencies of the sweep.

Wide (Order 13)

Gives the minimum sidelobes, providing the greatest dynamic range, but with some attenuation at the extremes of the frequency range.

User Set

Enables the window to be set manually to any type between minimum and wide. The following soft key can then be pressed to enable the window order to be set by the operator.

Set Window Order

Allows the window order to be to any value between 0 and 13.
This soft key is only selectable if manual mode has been selected, using the [User Set] soft key.

Rotary Control	×	Step Keys	×	Numeric Pad	√	Terminator	Any

Return to T Dom Funcs

Returns control to the Time Dom Funcs Menu.

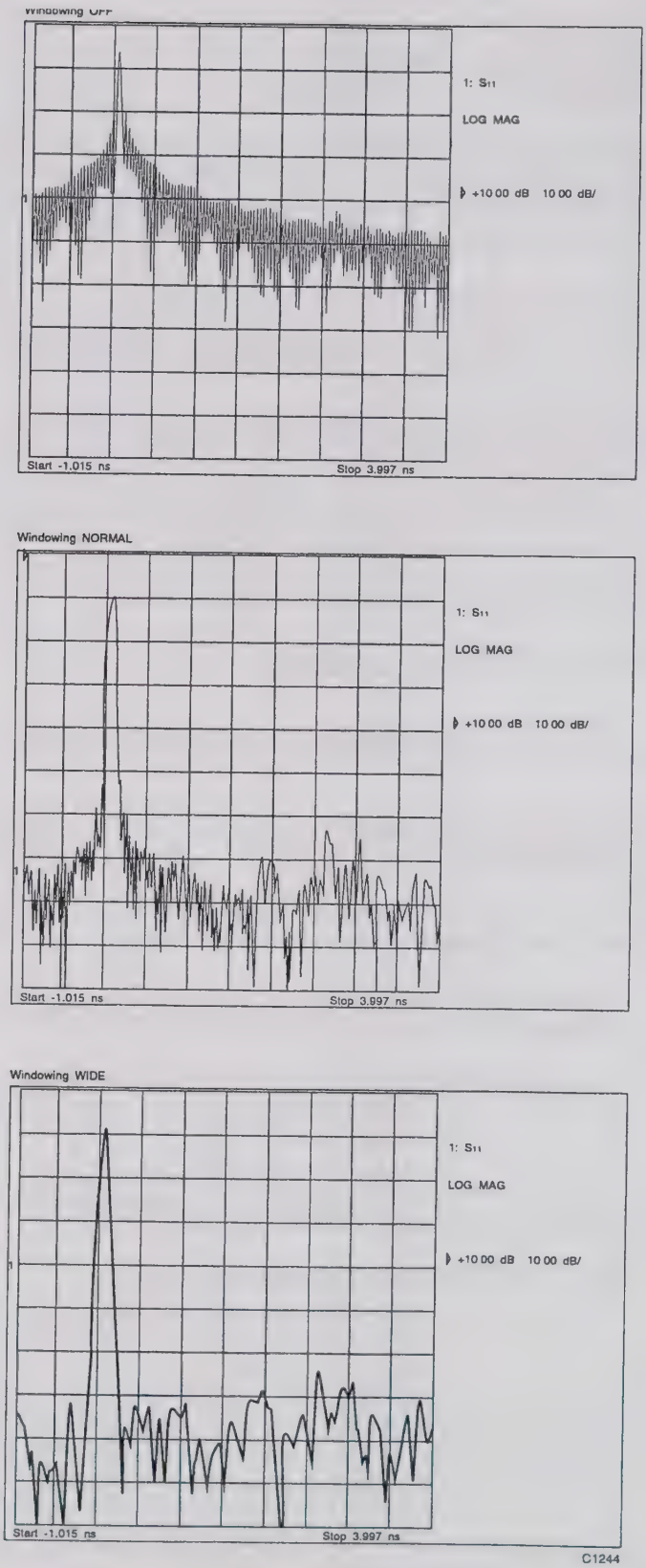


Fig. 3-56 Effect of Windowing on the Time Domain Response

Display Domain

This menu is used to select whether the time domain measurements are to be displayed in the time or distance domain. This setting also determines whether gate parameters (Gate / Fence Menu) are entered in units of time or distance.

For coax medium, distance units are converted from time units according to

$$\text{Distance} = \text{Time} \times c \times v_r$$

where c = speed of light in free space

v_r = relative velocity factor of the medium

The relative velocity for coax is set using the Character Dev Menu.

Time — Measurements are displayed in the time domain, i.e. the horizontal axis represents time.

Distance — Measurements are displayed in the distance domain, i.e. the horizontal axis represents distance. The units are selected by the following two soft keys.
This soft key is unselectable if the medium is waveguide but the sweep type is not a waveguide sweep.

Metres — Displays distance in metres. This applies instrument-wide.
This soft key will only be selectable if the distance domain has been selected.

Feet — Displays distance in feet. This applies instrument-wide.
This soft key will only be selectable if the distance domain has been selected.

Return to T Dom Funcs — Returns control to the Time Dom Funcs Menu.

Display Zoom

This menu enables the user to specify a sub-range of displayed domain values by entering the required start and stop values, or by specifying centre and span values. This effectively provides a magnification facility for a selected part of the range. Note that the sweep of the source remains constant; the magnification is accomplished by processing the measurement results. The zoom function applies per channel.

The display start and stop frequencies can also be set to the frequency value corresponding to the position of the active marker on the active measurement. This is done by pressing the appropriate soft key, positioning the active marker on the trace, then pressing the [×1] key on the numeric keypad.

If the centre & span mode has been selected, the centre value is set by pressing *[Set Display Cntr]*, positioning the active marker, then pressing the [×1] key on the numeric keypad. The span is set by pressing *[Set Display Span]*, positioning the delta marker to the appropriate point either side of the centre, then pressing the [×1] key. (If necessary, enable the delta marker from the Marker Menu.)

Set Display Start

If the start/stop mode has been selected, this soft key is used to change the start value of the displayed domain. In the centre/span mode this soft key is labelled *[Set Display Cntr]*, and is used to display the centre value of the displayed domain.

Frequency, Distance

Rotary Control	Step Keys	Numeric Pad	Terminator
√	√	√	10^{+}

Voltage, Current, Time

Rotary Control	Step Keys	Numeric Pad	Terminator
√	√	√	10^{-}

Power

Rotary Control	Step Keys	Numeric Pad	Terminator
√	√	√	Any

Set Display Stop

If the start/stop mode has been selected, this soft key is used to change the stop value of the displayed domain. In the centre/span mode this soft key is labelled *[Set Display Span]*, and is used to display the span of the displayed domain.

Values are entered as above.

Display as Start & Stop

Displays the domain as values between the start and stop values as defined above.

Display as Cntr & Span

Displays the domain as a centre value and span.

Return to Meas Funcs

Returns control to the Meas Funcs Menu.

More

Measure
(More)

This menu is a continuation of the Measure Menu.

Electrical Delay

Leads to the Elect Delay Menu, which allows an electrical delay to be introduced into the measurement.
See page 3-204.

Set Phase Offset

Used to apply a phase offset that is constant with frequency (rather than linear, as for electrical delay) to each measurement point of a live S_{11} measurement or a displayed memory. Values in the range ±360° can be entered, and applies to each measurement trace.

Rotary Control √	Step Keys √	Numeric Pad √	Terminator Any

Characterise Device

Leads to the Character Dev Menu, which enables characterisation of the device to be measured.
See page 3-205.

Smoothing

This function is the same as for a scalar channel.
This soft key is unselectable for polar/Smith formats.

Limit Checking

This function is the same as for a scalar channel.
This soft key is unselectable for polar/Smith formats.

General Set-up

This function is the same as for a scalar channel.
.

Return to Prior Menu

Returns control to the Measure Menu.

Elect Delay

This menu enables an electrical delay to be introduced into the measurement, by adding or subtracting phase in proportion to frequency. The delay has the effect of shifting the zero degrees reference point away from the test port and this can be used to compensate for the electrical lengths of cables or adapters which have been added to the DUT. This parameter applies per measurement.

If the medium is coaxial, the delay can be entered either as a physical length (L) in metres or an electrical delay (D) in seconds. The relationship between L and D is given by:

$$D = L / cv_r$$

where v_r is the relative velocity of the medium, and $c = 3x10^8$ m/s.

Alternatively, the medium can be characterised by its relative dielectric constant ε_r, from which v_r is calculated using:

$$v_r = 1 / \sqrt{\varepsilon_r}$$

assuming a relative permeability of 1.

Values for v_r or εr are entered using the Character Dev Menu

For waveguides, the delay can only be entered in metres. The waveguide medium is characterised by its cutoff frequency (f_c), and is entered using the *[Set Cutoff Frequency]* soft key. Using this value, v_r is computed for each frequency above f_c, and the delay is calculated from the entered length using:

$$D = L / cv_r$$

The electrical delay in degrees at each frequency point f is -360 Df.

Set Length

Used to set the electrical delay in metres. Values in the range ±300 Mm can be entered.

Rotary Control √	Step Keys √	Numeric Pad √	Terminator 10–

Set Time

Used to set the electrical delay in seconds. Values in the range ±1 s can be entered.
This soft key is unselectable if the medium is waveguide

Rotary Control √	Step Keys √	Numeric Pad √	Terminator 10+

Return to Measure

Returns control to the Measure Menu.

Character Dev

This menu is used to specify the characteristics of the system to be measured, and apply instrument-wide.

Set Char Impedance

Used to set the value of the system characteristic impedance, which is required for impedance and admittance calculations.

Rotary Control √	Step Keys √	Numeric Pad √	Terminator Any

Coax Medium

Used to specify that the medium of the device to be measured is coax.

Waveguide Medium

Used to specify that the medium of the device to be measured is waveguide.

Set Rel Velocity

Used to set the value of relative velocity for coaxial transmission medium. If the line consists of more than one section, and the relative velocities are significantly different, an 'average' value can be calculated for the composite line. The individual figures for relative velocity should be weighted to take account of the relative lengths of the sections, i.e. the longer the section, the greater the effect it has on the composite figure. (The relative velocity is 1 for most waveguides.)
This soft key is unselectable if the medium is waveguide.

Rotary Control √	Step Keys √	Numeric Pad √	Terminator Any

Set Dielec Constant

Used to set the value of the relative dielectric constant for coaxial transmission medium. For a multi-section line, a composite figure can be calculated as above.
This soft key is unselectable if the medium is waveguide.

Rotary Control √	Step Keys √	Numeric Pad √	Terminator Any

Set Cutoff Frequency

Used to set the waveguide cutoff frequency, and applies instrument-wide.
This soft key is unselectable if the medium is coaxial.

Rotary Control √	Step Keys √	Numeric Pad √	Terminator 10+

Return to Measure

Returns control to the Measure Menu.

Fig. 3-57 MEASURE Menu - Reflection Analyzer Channel

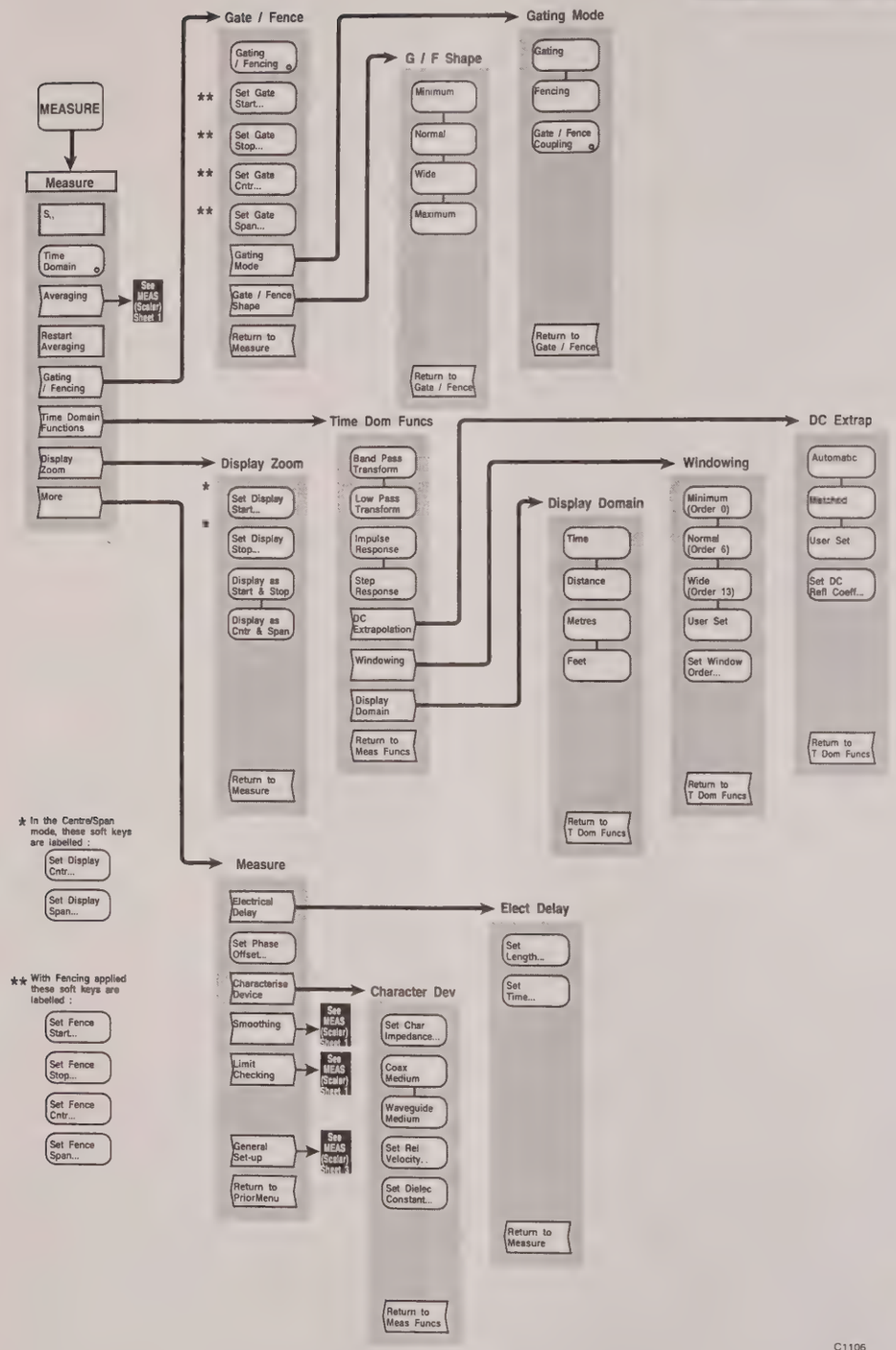


Fig. 3-57 MEASURE Menu - Reflection Analyzer Channel

[CAL] KEY

The [CAL] key provides access to the calibration menus (Fig. 3-59). Calibration is used in order to characterize the system and effectively remove system errors that cause uncertainty in measuring a device under test. For reflection measurements, errors are introduced which affect both magnitude and phase. Unlike a scalar channel, calibration does not just improve the accuracy of the measurement , it is a necessary part of the measurement procedure.

Calibration is performed by connecting known standard devices to the measurement port of the reflection analyzer and making measurements over the frequency range of interest. To accurately calibrate the measurement system three standards are required. The standards used are a short circuit, an open circuit and a matched load, since they cover the widest frequency range and are the most convenient to use. These standards are provided in the form of a calibration kit; one of several cal kits can be selected by the user. The true reflection coefficients of the standards can be found from data supplied with the cal kit. This is used together with the measured reflection coefficients in order to calculate the reflection coefficient of the device connected to the test port.

The standards used for calibration are as follows:

Coax	**Waveguide**
Short circuit	Short circuit
Open circuit	Offset short
Fixed load	Fixed load
Sliding load (8 positions)	Sliding load (5 positions)

For coax measurements, the fixed load is used for frequencies below 2 GHz, since it is impractical to use a sliding load at these frequencies. Above 2 GHz a sliding load can be used, and it also gives better accuracy. It is not possible to use an open circuit with waveguides because of the radiation from the open end, therefore offset shorts are used instead.

Since practical calibration standards are non-ideal, various parameters are used to characterize them. The characteristics of the devices in a cal kit are held in an associated cal kit store, and can be edited using the Edit Cal Kit Menu.

The following calibration types are available:

COAX	Short - Open - Load (fixed)
COAX	Short - Open - Load (fixed & sliding)
WAVEGUIDE	Short - Offset Short - Load (fixed sliding)
WAVEGUIDE	Short - Offset Short 1 - Offset Short 2

Any one of a number of stored calibrations can be applied to the current measurement The trace information area of the display indicates if calibration is being applied, and the identity of the calibration store. Measurements will not be displayed unless a valid calibration is present. If the calibration becomes invalid (e.g. due to subsequent changes in the source set-up), a warning message will be displayed and a "?" is displayed after the calibration identity. The *[Recall Cal Conditions]* soft key in the Measure Menu can be used to restore the instrument state to that which existed when the current calibration was performed.

Facilities are also provided for calibrating sensors and zeroing detectors/sensors; these are the same as for a scalar channel.

For a discussion of calibration techniques, refer to the example reflection analyzer measurement in the Getting Started Manual for the MTS.

Cal

This menu provides facilities for calibrating the measurement system for a reflection analyzer channel, saving the calibration for future use, and applying a previously stored calibration. It also provides access to menus for detector/sensor zeroing and sensor calibration.

Reflection Analyzer Cal

Leads to the Reflect Cal Menu, which is used to perform a reflection analyzer calibration.
See page 3-211.

Select Cal

Enables a reflection analyzer calibration to be loaded from an instrument store or a memory card by entering the required identity number. A form is displayed on the screen containing the names and identity numbers of the available calibration stores. The *[Page Up]* and *[Page Down]* soft keys are used to select the previous and next page of entries in the list. The trace information area indicates which calibration store is being used.

Rotary Control ×	Step Keys ×	Numeric Pad √	Terminator	Any

Recall Cal Conditions

Recalls the measurement conditions that were present when the reflection analyzer calibration was performed.

Edit Cal Kit Data

Leads to the Edit Cal Kit Menu, which is used to edit a cal kit data store. The user is first of all requested to select the cal kit to the be edited, by entering the required identity number.
See page 3-215.

Refl Analyzer Zero

This soft key is used to zero the detectors in the 6210 reflection analyzer.

Det / Sensor Zero

Leads to the Det/Sen Zero Menu, which is used for zeroing detectors/sensors.
See page 3-87.

Sensor Cal

Leads to the Sensor Cal Menu, which is used to zero the power sensor and to calibrate it against the reference.
This soft key will only be selectable if Input D is configured for a power sensor.
See page 3-88.

Power Ref

Toggles the power reference on and off. The reference can be used for example, to verify that the power sensor is functioning correctly. The Power Reference On indicator (PWRREF) will be present in the General Information Area at the top of the screen if a power reference signal is being output.

Reflection Analyzer Cal

Reflect Cal

This menu is used to carry out calibration on the currently active reflection analyzer channel, and to save the calibration if required.

A form is displayed on the screen (Fig. 3-58) containing the following calibration details:

Cal kit identity
Medium type
The type and sex of the connectors used in the cal kit
Calibration type.
Calibration position (test port or end of cable)

The following source set-up details are displayed:

Sweep type
Sweep range
Power level of sweep
Sweep time
Number of measurement points.

The instrument's detection mode and current averaging are also displayed.

Measurement calibrations are valid only for a specific source set-up, which must be defined before calibration is started.

Each standard in the selected cal kit is listed, together with its serial number and an indication of whether or not it has been measured. For waveguide calibration kits the lengths of the offset shorts will also be displayed. The calibration kit to be used is selected by using the *[Select Cal Kit]* soft key.

Initially, the calibration details displayed will be those of the last calibration performed. If a calibration has not yet been done then default data will be displayed. When a selection has been made using the following soft keys, the information in the form will be updated appropriately.

If either of the waveguide calibration types is chosen and the calibration kit cutoff frequency is different to the instrument-wide cutoff frequency ([MEASURE] key), then the user will be asked whether the instrument-wide cutoff frequency is to be set to the calibration kit cutoff frequency value.

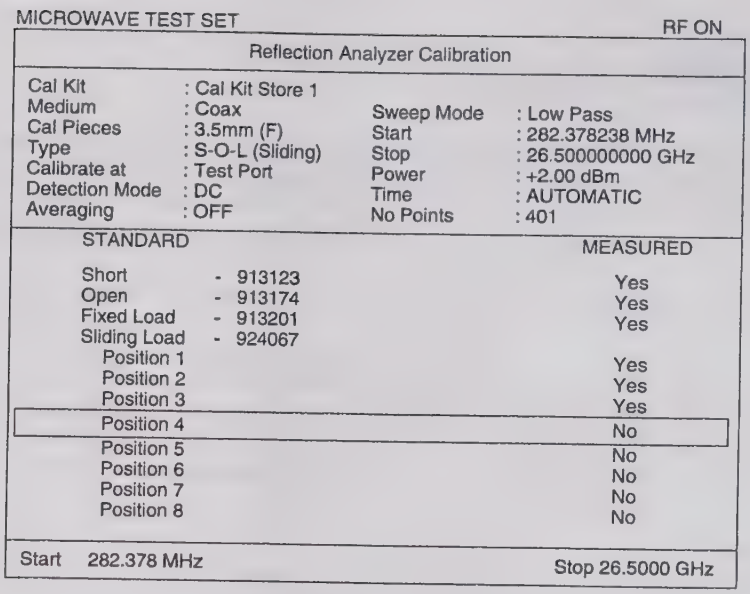


Fig. 3-58 Reflection Analyzer Calibration Details Form

Measure Standards

Used to perform a measurement of the selected standard. A sub-menu is displayed with the following soft keys:

[Process Meas]
[Measure Standard]
[⇑]
[⇓]
[Abort Calibration]

The standard to be measured is indicated by a highlight box around the standard's name, which can be moved up and down the list using the *[⇑]* and *[⇓]* soft keys. Standards can be measured in any order, and the measurement may be repeated if desired. After the standard has been connected to the test port, the *[Measure Standard]* soft key is pressed to initiate the measurement

While calibration data is being acquired, a message is displayed informing the user which standard is being measured, together with a percentage complete indicator.

Once all the standards have been measured, the *[Process Meas]* soft key will become selectable. When this is pressed, the MTS completes the calibration process by performing the necessary calculations on the calibration data. A percentage complete indicator will be displayed during this process.

When calibration is complete, the following soft keys will become available:

[Save Calibration]
[Select Store]
[Abort Calibration]

The *[Select Store]* soft key is used to select the store for saving the calibration, by entering the required store id number. The new calibration can then be saved to the specified store by pressing the *[Save Calibration]* soft key. Four internal stores are available in the MTS; alternatively, reflection analyzer calibrations can be stored on a memory card. At this point, the opportunity is given to change the id name of the store, if required.

Once the calibration has been performed and saved it will be used by the instrument.

Select Cal Kit

Used to specify the cal kit that will be used for calibration, by entering the required identity number. A form is displayed listing the names and identity numbers of the available cal kits, stored internally or on a memory card. The *[Page Up]* and *[Page Down]* soft keys are used to select the previous and next page of entries in the list.

Rotary Control ×	Step Keys ×	Numeric Pad √	Terminator	Any

Short, Open Fixed Load

Used to select a coaxial calibration which measures the following standards:
Short - Open - Fixed Load

If a waveguide calibration kit has been selected, this soft key will be labelled *[Short, Offset Short, Load]*, and is used to measure the following standards:
Short - Offset Short - Load

Short, Open Siding Load

Used to select a coaxial calibration which measures the following standards:
Short - Open - Sliding Load

If a waveguide calibration has been selected, this soft key will be labelled *[Short, Offset Shorts]*, and is used to measure the following standards:
Short - Offset Short 1 - Offset Short 2

Male

Specifies male type cal pieces for coaxial calibration.
Unselectable if a 7 mm calibration kit has been selected.
Labelled [Short, Offset, Sliding Load] if a waveguide cal kit has been selected.

Female

Specifies female type cal pieces for coaxial calibration.
Unselectable if a 7 mm calibration kit has been selected.
Not displayed if a waveguide calibratin kit has been selected.

Set Up Calibration

Leads to the Set Up Cal Menu
See page 3-214.

Abort Calibration

Terminates the calibration process. The current calibration store will not be affected.

Set Up Cal	**This menu is used to set up the calibration.**
Calibrate at Test Port	Enables calibration to be carried out at the Test Port of the Reflection Analyzer.
Calibrate at End of Cable	Enables calibration to be carried out at the end of a coaxial cable connected to the Test Port.
Set Up Source	Leads to the top level Source Menu for the Reflection Analyzer Channel. However, the *[RF]* soft key is not present and *[Source Functions]* is replaced by a 'Return' key.
Averaging	Leads to the Averaging Menu. *See page 3-54.*
AC Detection	This is the same as for the Measure Menu *See page 3-62.*
DC Detection	This is the same as for the Measure Menu. *See page 3-62.*
Return to Reflect Cal	Returns control to the Reflect Cal Menu.

Edit Cal Kit

This menu is used to edit a cal kit data store. Each store is associated with a cal kit, and contains the data which is used to characterize the standards comprising the cal kit.

The cal kit to be edited must first be selected. When the *[Select Cal Kit]* soft key is pressed, a form is displayed showing the names and identity numbers of the available cal kits. Once a cal kit has been selected, another form is displayed containing the following details:

Cal kit id number and name
Connector type (e.g. Coaxial, 3.5mm)
Cal data as follows:

Cal data for coaxial devices:

- Short offset length
- Open offset length
- 4 open fringing coefficients
- Fixed load offset length
- Fixed load break frequency
- Sliding load break frequency

For sexed coaxial connectors, the data is displayed in two columns, one containing the male data and one the female data.

Cal data for waveguide devices:

- Short offset length
- Offset short 1 offset length
- Offset short 1 minimum frequency
- Offset short 1 maximum frequency
- Offset short 2 offset length
- Offset short 2 minimum frequency
- Offset short 2 maximum frequency
- Load offset length
- Waveguide cutoff frequency

The *[Set Connector]* soft key is used to select the connector type to be edited, (e.g. 3.5 mm, N-type). The parameter to be edited is indicated by a highlight box around the parameter's name, which can be moved up and down the list using the *[⇑]* and *[⇓]* soft keys. If appropriate, the *[⇒]* soft key can be used to change between the male and female columns. The serial numbers of the calibration pieces can be changed by selecting the appropriate field using the *[⇑] and [⇓]* soft keys and then using the *[Set Serial No]* soft key. This displays a text entry form containing the serial number, which can then be edited. When editing has been completed, the cal kit data can be saved using the *[Save Cal Kit]* soft key; it can be saved under a different name by means of the *[Set Identity]* soft key. The *[Set Identity]* soft key is displayed in place of *[Set Serial No]* when the selected parameter is the calibration kit identity.

The cal kit parameters are entered as follows:

Offset Length

Rotary Control ×	Step Keys ×	Numeric Pad √	Terminator 10–

Frequency

Rotary Control	×	Step Keys	×	Numeric Pad	√	Terminator	10+

Fringing Coefficient Mantissa

Rotary Control	×	Step Keys	×	Numeric Pad	√	Terminator	Any

Fringing Coefficient Exponent

Rotary Control	×	Step Keys	×	Numeric Pad	√	Terminator	Any

Select Cal Kit

Used to select the cal kit to be edited by entering the required identity number.

Rotary Control	×	Step Keys	×	Numeric Pad	√	Terminator	Any

Set Connector

Leads to the Connector Menu.
See page 3-217.

Set Serial No

Used to change the serial number of the selected calibration piece. A text entry form is displayed on the screen, which is the same as that described for the Screen Title Menu (page 3-276).

If the selected parameter is the calibration kit identity, this soft key is labelled *[Set Identity]*. A text entry form is displayed enabling the identity to be edited.
This soft key is only selectable if the selected parameter is a cal kit identity or serial number.

⇒

Used to select between the male and female data columns (for sexed coaxial connectors). If the currently selected column is female, this soft key will be labelled [⇐].
This soft key will only be selectable for sexed coaxial connectors.

⇑

Makes the previous entry in the table the active entry.

⇓

Makes the next entry in the table the active entry.

Save Cal Kit

Causes the cal kit data to be saved in non-volatile memory.

Return to Cal

Returns control to the Cal Menu.

Connector — **This menu is used to specify the type of connectors used on the standard devices of the cal kit to be used for calibration.**

3.5 mm — Specifies 3.5 mm coaxial connectors.

N — Specifies N-type coaxial connectors.

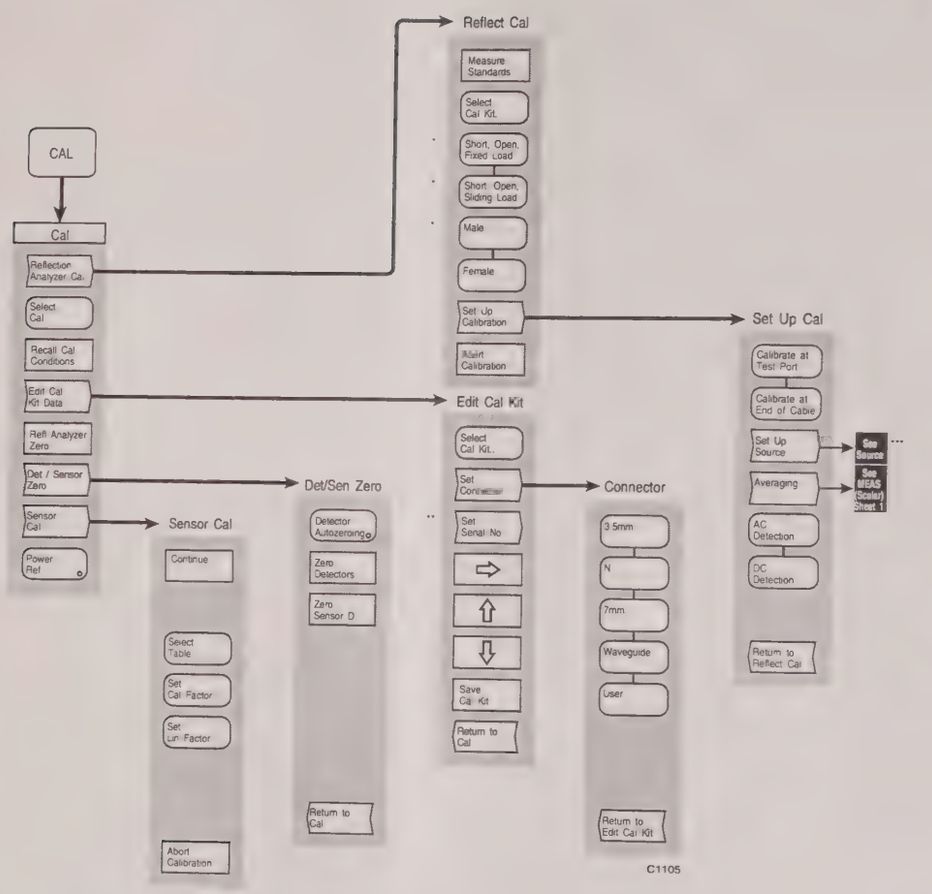
7 mm — Specifies 7 mm coaxial connectors.

Waveguide — Specifies waveguide connectors.

User — Specifies a connector type defined by the user. Parameters for user-defined connector types are entered using the Edit Cal Kit Menu (see page 3-215).

Return to Edit Cal Kit — Returns control to the Edit Cal Kit Menu.

Fig. 3-59 CAL Menu - Reflection Analyzer Channel



*With a waveguide calibration kit, these soft keys are labelled

Short, Offset Short, Load

Short, Offset Shorts

Short, Offset Sliding Load

**When the cal kit identity field is selected this soft key is labelled

Set Identity

***This is the same as the source menu structure for the reflection analyzer. However the 'RF' key and the 'Source Functions' keys have been removed with the latter being replaced by a 'Return' key

Fig. 3-59 CAL Menu - Reflection Analyzer Channel

[FORMAT] KEY

The [FORMAT] key enables the reflection analyzer measurement to be displayed in the required format, i.e. the units in which the response (vertical axis) is scaled.

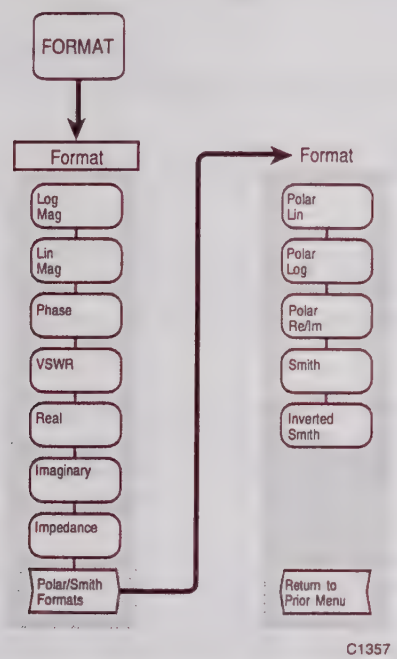


Fig. 3-60 FORMAT Menu - Reflection Analyzer Channel

Format

This menu enables one of several display formats to be selected.

In the following, the complex reflection coefficient at the test device input (S_{11}) is represented by Γ, where $\Gamma = \frac{\text{reflected voltage}}{\text{incident voltage}}$

The following display formats are available:

Cartesian formats

Linear magnitude of complex reflection coefficient, $|\Gamma|$
Log magnitude of Γ
Phase angle of Γ in degrees
Real part of Γ
Imaginary part of Γ
VSWR ($= (1 + |\Gamma|)/(1 - |\Gamma|)$.
Input impedance $\left(Z_0 \frac{1+\Gamma}{1-\Gamma}\right)$

Polar/Smith formats

Polar linear, i.e. $|\Gamma|$, phase angle
Polar log, i.e. 20 log$|\Gamma|$, phase angle
Polar Re/Im, i.e. Re(Γ), Im(Γ)
Smith chart
Inverted Smith chart

If a low pass transform has been selected the phase and imaginary formats are not available. This is because these formats would present no information, since the imaginary part of the reflection coefficient would always be zero with a low pass transform.

If a low pass transform is selected while in the time (or distance) domain, and the current format is not permitted (i.e. Phase or Imaginary), a warning will be displayed and the format will be set to Real.

The format selected applies per measurement. It is not possible to display both a cartesian format and a polar/Smith format within the same channel.

Log Mag
Displays log magnitude of $|\Gamma|$ in dB, i.e. 20 $\log_{10} |\Gamma|$. Note that this is the same as return loss, but expressed as a negative quantity.

Lin Mag
Displays linear magnitude of complex reflection coefficient, $|\Gamma|$.

Phase
Displays phase angle of Γ in degrees, i.e. $\tan^{-1}(\text{Im}(\Gamma)/\text{Re}(\Gamma))$.
This soft key is unselectable if the low pass time domain option has been selected.

VSWR
Displays VSWR, i.e. $(1 + |\Gamma|)/(1 - |\Gamma|)$.

Real
Displays the real part of Γ.

Imaginary
Displays the imaginary part of Γ.
This soft key is unselectable if the low pass time domain option has been selected.

Impedance

Displays the input impedance, i.e. $Z_0 \frac{1+\Gamma}{1-\Gamma}$.

Unselectable unless the measurement is a low pass step response time domain one.

Polar/Smith Formats

Leads to a sub-menu, which enables various types of polar/Smith formats to be selected.
This soft key is unselectable if time domain is turned on.
See page 3-223.

FORMAT — Polar/Smith Formats

Format (Polar/Smith Formats)

This is a continuation of the previous menu, and allows polar or Smith formats to be selected.

Polar and Smith formats display the same measurement (i.e. reflection coefficient, Γ), but it is interpreted differently in each case by superimposing a different graticule and/or by processing the marker readout in a different way. Examples of these formats are shown in Fig. 3-61.

Polar Lin

Displays the reflection coefficient in polar format; each point corresponds to a particular value of both magnitude and phase. Quantities are read vectorally: the magnitude at any point is determined by its displacement from the centre, and the phase by the angle anti-clockwise from the positive x-axis.

The graticule comprises five equally spaced concentric circles. Magnitude is scaled linearly, from zero at the centre to the value represented by the outer circle. This value is equal to the reference level, which is set using the [SCALING] key. Markers can be used to obtain a readout of magnitude and phase corresponding to any point on the trace.

Polar Log

This provides a similar display to the polar lin format, except that the marker readout of magnitude is $20 \log_{10}|\Gamma|$.

Polar Re/Im

This provides a similar display to the polar lin format, except that the marker readout gives Re(Γ) and Im(Γ).

Smith

Provides impedance measurements in the form of a Smith chart. The Smith chart is essentially a polar diagram on which are superimposed loci of constant resistance and reactance, thus enabling the impedance at any point along a transmission line to be obtained. These values are normalized to the characteristic impedance of the system. As for the polar format, the radius corresponds to the magnitude of the reflection coefficient, and the angle corresponds to the phase of the reflection coefficient. The marker readout of impedance (R+jX) is given in units of resistance (R) and reactance (X) (i.e. the real and imaginary parts of the complex impedance).

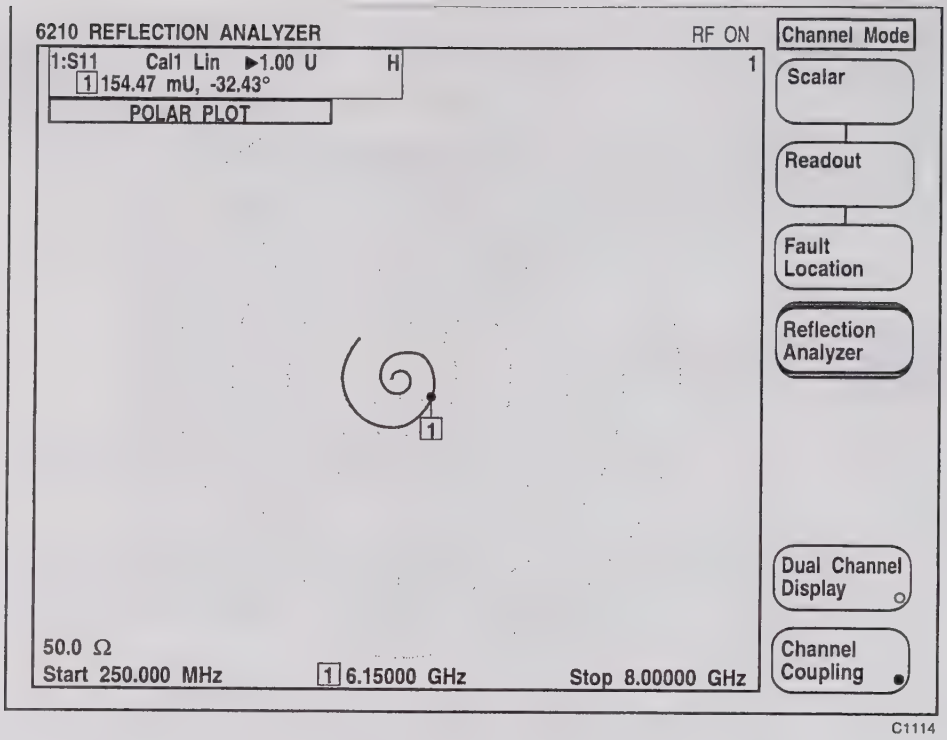
If a reference level value of less than 0.1 is set (using the Scaling Menu) while in this mode, the display will revert to the polar format.

Inverted Smith

This format is similar to above, but is used for admittance measurements, where the loci now represent constant conductance (G) and susceptance (B). The marker readout of admittance (G+jB) is given in terms of these quantities.

Return to Prior Menu

Returns control to the Format Menu.



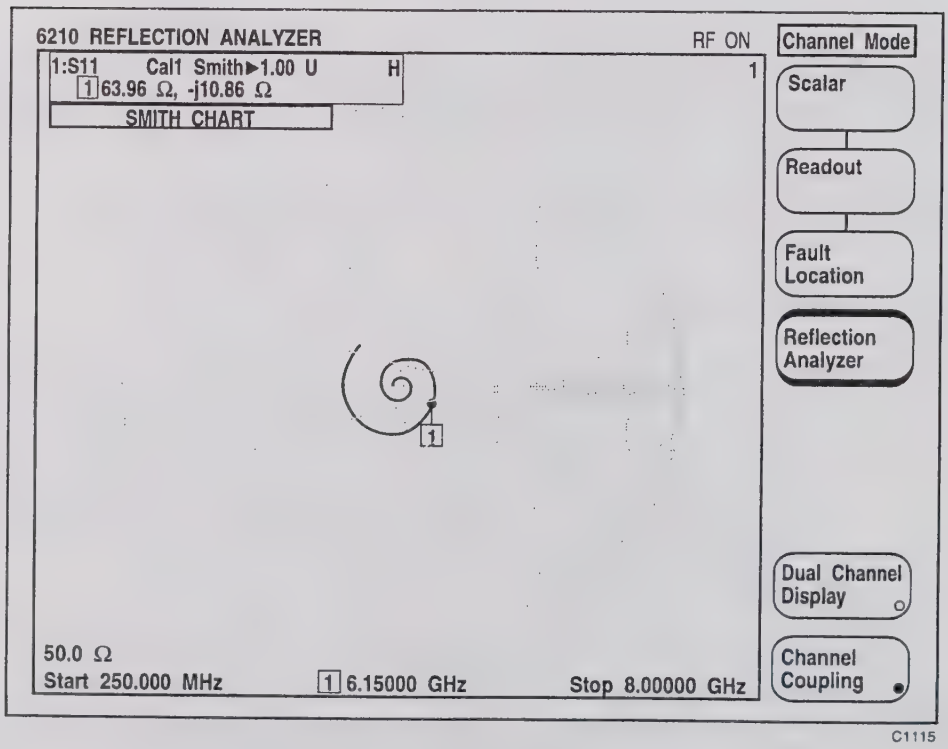


Fig. 3-61 Typical Polar and Smith Format Displays

[SCALING] KEY

The [SCALING] key provides a menu which enables the user to adjust the positioning and scaling of the currently active trace, or to allow the instrument to set the scaling automatically.

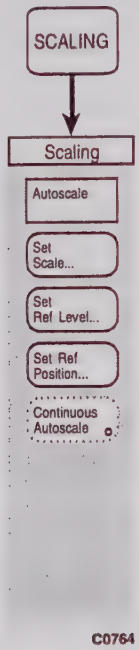


Fig. 3-62 SCALING Menu - Reflection Analyzer Channel

Scaling

This menu enables the user to set the reference level and scaling for a trace.

Cartesian Formats

The reference position is the position on the vertical axis that remains fixed during scaling. This is indicated on the screen by the Reference Position Indicator (see the 'Display' section). The reference level is the value corresponding to the position of the Reference Position Indicator on the vertical scale, and is displayed in the relevant trace information area. The scaling value is the number of units per vertical division.

The default values for reference level and scaling factor for each type of format are listed below.

	Reference Level*	Scale Factor
Lin magnitude	1 (line 10)	0.1 /div
Log magnitude	0 dB (line 10)	5 dB/div
Phase	0° (line 5)	45°/div
Real	0 (line 5)	0.2 /div
Imaginary	0 (line 5)	0.2 /div
VSWR	1 (line 1)	1 /div
Impedance	50 Ω (line 5)	1.00 Ω/div

* Line 0 = bottom; line 10 = top.

Polar/Smith Format

The graticule for the polar format comprises five equally spaced concentric rings, with radial lines at 45° intervals. The reference level is the linear magnitude value corresponding to the outer circle. The scaling value is the linear magnitude value corresponding to the innermost circle. Since the graticule always consists of five circles, the scaling value is always one fifth of the reference level. Thus either the reference level or scaling value may be entered, and the instrument will calculate the other value.

For Smith formats, only the outer concentric ring is displayed, but the method of scaling is the same as for the polar display.

The default values for reference level and scaling factor for polar/Smith formats are listed below.

	Reference Level	Scale Factor
All formats	1 (magnitude of ref. coefficient)	0.2

The parameters in this menu apply per trace.

Autoscale

Cartesian formats

Allows the instrument to determine optimum values of scale and reference level, such that the trace occupies approximately 80% of the graticule height. The value chosen for the scale factor will be selected from a 1,2,5 sequence. The value chosen for the reference level will be a multiple of the chosen scaling factor. The reference position will remain unchanged.

Smith/polar formats

The smallest reference level value will be selected from a 1,2,5 sequence such that the whole of the measurement lies within the outer circle.

Set Scale

Used to set the scale factor for a trace.

Log Magnitude Format

Rotary Control	√	Step Keys	√	Numeric Pad	√	Terminator	Any

Lin Magnitude, Real and Imaginary Formats

Rotary Control	√	Step Keys	√	Numeric Pad	√	Terminator	10–

Phase Format

Rotary Control	√	Step Keys	√	Numeric Pad	√	Terminator	Any

VSWR Format

Rotary Control	√	Step Keys	√	Numeric Pad	√	Terminator	Any

Smith/Polar Formats

Rotary Control	√	Step Keys	√	Numeric Pad	√	Terminator	10–

Set Ref Level

Used to set the reference level for a trace.

Numeric entry as above.

The reference level can also be set to the response measured at the active marker position, by pressing this soft key followed by the [×1] key on the numeric keypad.

Set Ref Position

Used to set the reference position for a trace. The reference position may be placed on any of the 11 horizontal lines of the graticule.

This soft key is unselectable for Smith/polar formats.

Rotary Control	√	Step Keys	√	Numeric Pad	×	Terminator	×

Continuous Autoscale

This soft key is unselectable.

[MARKERS] KEY

The MTS can display up to eight markers per trace, with each marker identified by a number. Any one of these can be designated the active marker, indicated by a box around the number to distinguish it from the normal markers. The active marker can be moved along the x-axis using the step keys, rotary control or by keyboard entry. The step keys and keyboard entry are only available through the Position Active Mkr and Position Delta Mkr functions of the Markers Menu. The rotary control can be used to move the active marker at any time whilst it is displayed, provided that no other from of numeric entry is active. The domain value (x-axis position) of the active marker is displayed below the graticule, and the measured response at this position is displayed in the relevant trace information area. For Polar/Smith formats, a complex (2 part) number will be displayed.

The delta marker mode provides an additional marker, designated the delta marker, and is represented by Δ on the display. In this mode, the domain value of the active marker is relative to the delta marker position. The measured response is relative to the response at the delta marker position, i.e.

Domain value = Active Marker position – Delta Marker position
Response = Active Marker response – Delta Marker response

Note that the distance (or time) values indicated by the active marker represent the actual distance (or time) to a discontinuity, not the round trip distance.

The marker menus are shown in Fig. 3-63.

A tracking facility is available for the max/min, peak-to-peak and bandwidth functions. This enables the function to be automatically applied at each measurement update (i.e. at the end of each sweep).

Markers — **This menu provides soft keys for setting up markers and using them to perform various types of measurement.**

Active Mkr

Toggles the active marker on or off. Turning off the active marker also turns off the delta Marker. Once the active marker is turned on it can be positioned any where along the graticule using the rotary control. To set the active marker to a specific domain value using the numeric keypad the *[Position Active Mkr]* soft key must be selected.

Place Mkr at Active

Used to place a marker at the active marker position by entering the required number.

Rotary Control	×	Step Keys	×	Numeric Pad	√	Terminator	None

Position Active Mkr

Used to change the domain value (x-axis position) of the active marker, by entering the new value as follows:

Frequency

Rotary Control	√	Step Keys	√	Numeric Pad	√	Terminator	10+

Power

Rotary Control	√	Step Keys	√	Numeric Pad	√	Terminator	Any

Voltage/current

Rotary Control	√	Step Keys	√	Numeric Pad	√	Terminator	10–

Time

Rotary Control	√	Step Keys	√	Numeric Pad	√	Terminator	10–

Distance

Rotary Control	√	Step Keys	√	Numeric Pad	√	Terminator	10+

This soft key will only be selectable if the active marker is turned on.

Delta Mkr

Toggles the delta marker on or off. Turning on the delta marker also turns on the active marker.

Position Delta Mkr

Used to change the position of the delta marker, using the same method as for the active marker.
This soft key will only be selectable if the delta marker is turned on.

All Mkrs Off

Turns off all markers for the currently active trace.

Mkr Functions

Leads to the Mkr Funcs Menu, which enables various measurement functions to be carried out by means of the active marker and delta marker.
See page 3-230.

Set Up Mkrs

Leads to the Set Up Mkrs Menu, which allows the user to activate and position selected markers.
See page 3-232.

Mkr Funcs

This menu leads to sub-menus for locating the maximum and minimum points on a trace, measuring the peak-to-peak ripple, searching for a specified response value, performing bandwidth measurements, measuring the slope of a trace, and locating multiple peaks in the time domain response.

Marker to Max/Min

Leads to the Max Min Menu
See page 3-98.

dB/Octave dB/Decade

Leads to the dB/O dB/D Menu.

This soft key is only selectable if the domain is frequency, start frequency is < stop frequency, source mode is not linear list sweep, format is log magnitude, and time domain is turned off.
See page 3-98.

Peak to Peak

Leads to the Peak to Peak Menu, which enables measurement of peak-to-peak ripple.
This soft key is only selectable if the format is log magnitude.
See page 3-99.

Search

Leads to the Search Menu, which is used to locate a response value on the screen.
This soft key is unselectable for polar and Smith format measurements.
See page 3-231.

Bandwidth

Leads to the Bandwidth Menu, which is used for bandwidth measurements.
This soft key is only selectable if the format is log magnitude, the source mode is a frequency sweep and time domain is turned off.
See page 3-101.

Find Next Peak

Leads to the Find Next Pk Menu.
This soft key is only selectable if time domain is turned on.
See page 3-231.

Return to Markers

Returns control to the Markers Menu.

Search

This menu is used for locating a response value on the trace that has previously been specified by the user. The search facility can also be used in delta marker mode.

Search Left

Causes the system to search left from the current active marker position in order to find the response value specified with the *[Set Search Value]* soft key. The active marker will be placed at this position. If two adjacent measurement points encompass the search value, the active marker will be placed at the measurement point which is nearer to the search value. If the search value cannot be found, a message will be displayed indicating this, and the active marker will not be moved.

Search Right

As above, but the search direction is right.

Set Search Value

Sets the value that will be searched for.

Log Magnitude Format

Rotary Control	Step Keys	Numeric Pad	Terminator
√	√	√	Any

Lin Magnitude, Real and Imaginary Format

Rotary Control	Step Keys	Numeric Pad	Terminator
√	√	√	10–

Phase Format

Rotary Control	Step Keys	Numeric Pad	Terminator
√	√	√	Any

VSWR Format

Rotary Control	Step Keys	Numeric Pad	Terminator
√	√	√	Any

Return to Mkr Funcs

Returns control to the Mkr Funcs Menu.

Find Next Pk

This menu enables the active marker to be placed at peaks in the time domain trace.

Find Next Peak Right

Positions the active marker at the next peak in the trace to the right of its current position. The peak that the active marker moves to is defined to be the next local maximum visible on the screen to the right of the current active marker position. If a peak cannot be found, the active marker will remain at its current position.

Find Next Peak Left

As above, but the next peak to the left of the current active marker position is located.

Returns to Mkr Funcs

Return control to the Mkr Funcs Menu.

Set Up Mkrs

This menu enables selected markers to be turned on or off and positioned on the display, and allows one of the markers to be selected as the active marker. For frequency sweep measurements, the menu provides two alternative display resolutions for marker positions. A soft key is also provided to turn marker coupling between channels on or off.

Assign Active Mkr 1-8

Used to select the marker which will act as the active marker.

Rotary Control	Step Keys	Numeric Pad	Terminator	
×	×	√	None	

Mkr 1-8 On

Turns a selected marker on by entering the required marker number.

Rotary Control	Step Keys	Numeric Pad	Terminator	
×	×	√	None	

Mkr 1-8 Off

Turns a selected marker off by entering the required marker number.

Rotary Control	Step Keys	Numeric Pad	Terminator	
×	×	√	None	

Position Mkr 1-8

Used to change the domain value (x-axis position) of a specified marker. A form is displayed on the screen containing numeric entry fields for the marker number and the marker position. The required marker is selected then its position is changed.

This soft key will only be selectable if the active marker is turned on.

Marker Number

Rotary Control	Step Keys	Numeric Pad	Terminator	
×	×	√	None	

Marker Position (Frequency Domain)

Rotary Control	Step Keys	Numeric Pad	Terminator	
√	√	√	Any	

Marker Position (Power Domain)

Rotary Control	Step Keys	Numeric Pad	Terminator	
√	√	√	Any	

Marker Position (Voltage or Current Domain)

Rotary Control	Step Keys	Numeric Pad	Terminator	
√	√	√	10^{-}	

Marker Position (Time Domain)

Rotary Control	Step Keys	Numeric Pad	Terminator	
√	√	√	10^{-}	

Marker Position (Distance Domain)

Rotary Control	Step Keys	Numeric Pad	Terminator	
√	√	√	10^{+}	

6 Digits Resolution

Sets the displayed resolution for marker frequency information to six digits.
This soft key is only selectable when the domain is frequency.

1 Hz Resolution

Sets the displayed resolution for marker frequency information to 1 Hz.
This soft key is only selectable when the domain is frequency.

Mkr Coupling

Toggles marker coupling between channels on or off. When marker coupling is enabled, the positions (i.e. domain or x-axis values) of all markers on all traces will track the positions of the markers on the active trace of the active channel. When marker coupling is disabled, markers may be positioned independently on each channel. The default setting for marker coupling is on.

Marker coupling can only be disabled when channel coupling is switched off (Channel Mode Menu).

Return to Markers

Returns control to the Markers Menu.

Fig. 3-63 MARKERS Menus - Reflection Analyzer Channel

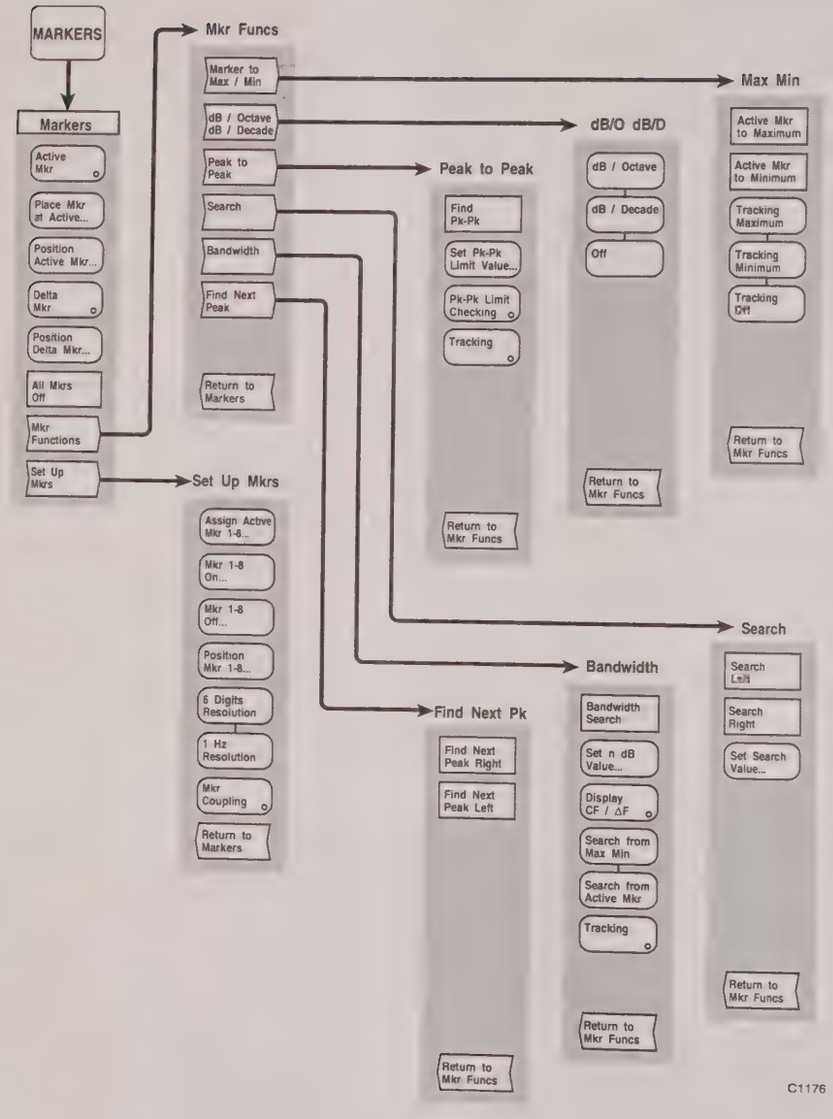


Fig. 3-63 MARKERS Menus - Reflection Analyzer Channel

[COPY] KEY

The [COPY] key provides access to the menus shown in Fig. 3-64, which enables hard copy output to be obtained using a suitable parallel printer or a GPIB plotter with HPGL language (e.g. HP7470A/7475A). The system allows further measurements to be made while printing or plotting is in progress. Refer to Chapter 1 for information on recommended printers and plotters for the MTS.

Notes

(1) If a Canon BJ10 printer is used, DIP switches 9, 7 and 11 must be set to OFF.

(2) If an HP DeskJet printer is used, DIP switch Bank B number 1 must be set up (66 lines/page).

(3) Pressing the [COPY] key on power up will result in the instrument's build state being printed out on the printer.

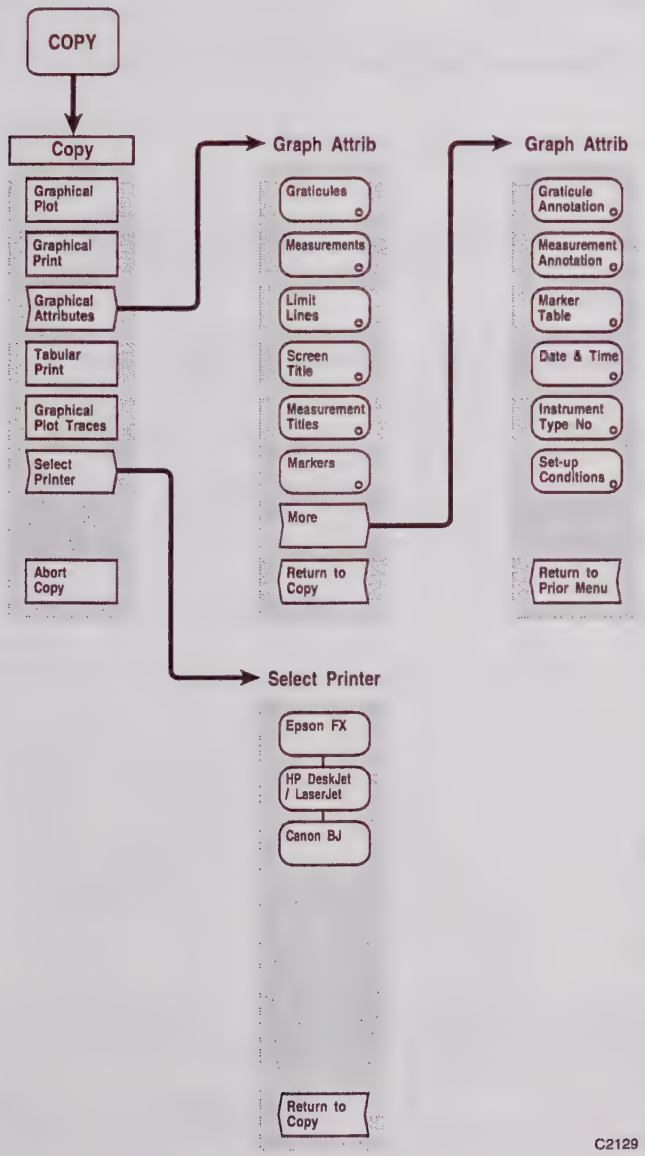


Fig. 3-64 COPY Menus

Copy — **The Copy Menu enables printing/plotting of measurements.**

Graphical Plot — Initiates output of graphics information to the plotter. The information that is plotted is determined by the selection made using the menu accessed via the *[Graphical Attributes]* soft key. Note that only pens 1, 2 and 3 in a multi-pen carousel are used during plotting.

Graphical Print — Initiates output of graphics information to the printer. The information that is printed is determined by the selection made using the menu accessed via the *[Graphical Attributes]* soft key.

Graphical Attributes — Leads to the Graph Attrib Menu, which allows the user to determine which information is output to the printer or plotter.
See page 3-239.

Graphical Plot Traces — Initiates plotting of only the currently displayed traces(s), without any attributes.

Tabular Print — Used for tabular output of trace data.

Select Printer — Leads to the Select Printer Menu, which allows the user to select which type of printer is connected to the Parallel Printer port (i.e. Epson FX, HP DeskJet/LaserJet or Canon BJ series).

Abort Copy — Terminates output of information to the device being used.

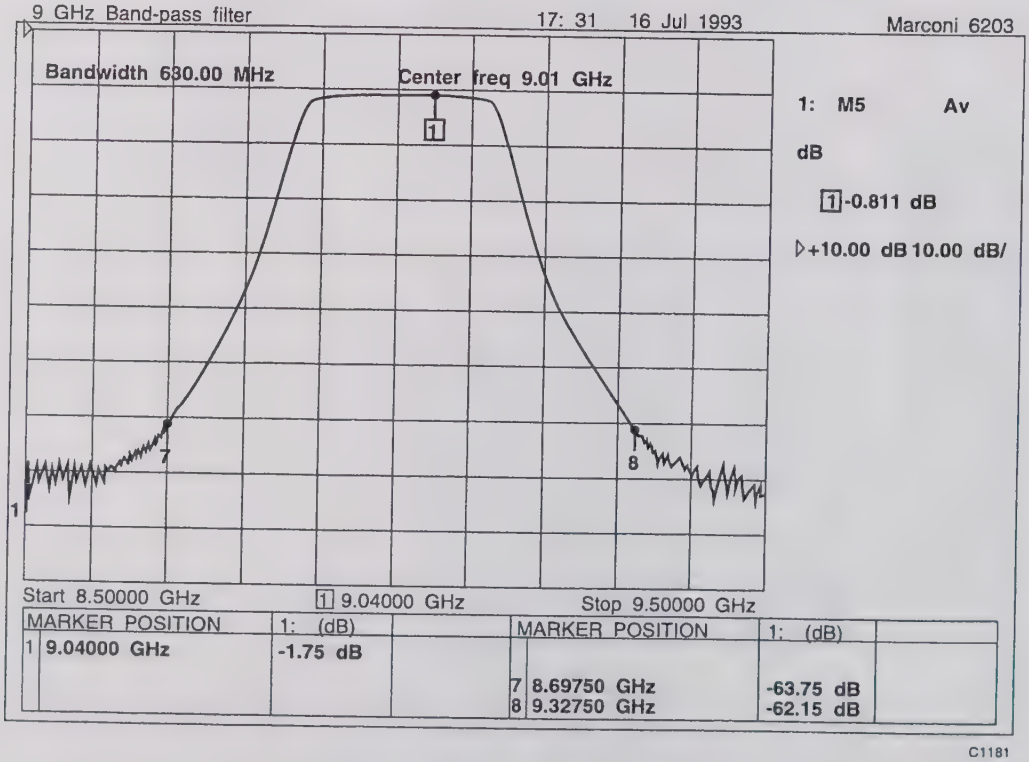


Fig. 3-65 Typical Plotter Output

Graph Attrib

All of the soft keys in this menu (except for *[More]* and *[Return to Copy]*) perform an on/off action, and are used to specify which of the elements of the display are to be sent to the output device.

The graphical data available for plotting/printing depends on what is being displayed on the screen at the time the plot/print command is received. For example, if bandwidth or peak-to-peak measurements have been made, the displayed results will appear on the plot. The appearance of the plot/print will resemble that of the screen display with the addition of information to identify traces and their corresponding limit lines and measurement titles so that a monochrome plot/print (or photocopy) may be easily interpreted.

Graticules Specifies printing/plotting of graticules.

Measurements Specifies printing/plotting of measurements (traces or readings).

Limit Lines Specifies printing/plotting of limit lines.

Screen Title Specifies printing/plotting of the screen title. The screen title applies to the whole display, and appears at the top of the screen. Screen titles can be entered and switched on or off by using the Titles Menu ([UTILITY]*[Titles]*).

Measurement Titles Specifies printing/plotting of measurement titles. A channel may display up to two measurement titles, one for each trace or readout. Measurement titles can be entered and switched on or off by using the Titles Menu ([UTILITY]*[Titles]*). A measurement title will be displayed only when both it and the corresponding trace or readout are switched on.

Markers Specifies printing/plotting of markers.

More Leads to the menu on the following page which is a continuation of this one.

Return to Copy Returns control to the Copy Menu.

Graph Attrib

This menu is a continuation of the Graph Attrib Menu.

Graticule Annotation

Specifies printing/plotting of the graticule annotation (the domain values at the bottom of the display).

Measurement Annotation

Specifies printing/plotting of measurement annotation. For a scalar channel this comprises the data within the trace information area and the Pass/Fail indication. For a readout channel, the readout plus the associated information is output to the printer/plotter.

Marker Table

Specifies printing/plotting of the marker summary table.

Date & Time

Specifies printing/plotting of the date and time.

Instrument Type No

Specifies printing/plotting of the instrument type number.

Set-up Conditions

Specifies printing/plotting of the following set-up conditions:

- Source output power (not applicable for power sweep)
- AC/DC detection (not applicable for readout channels)
- Sweep time (only applicable for swept source modes)
- Number of sweep points (only applicable for swept source modes)

Return to Prior Menu

Returns control to the first Graph Attrib Menu.

[SAVE/RECALL] KEY

The [SAVE/RECALL] key provides access to the menus shown in Fig. 3-66, which enables the current instrument settings or measurement traces to be saved or recalled to or from a memory location specified by the user.

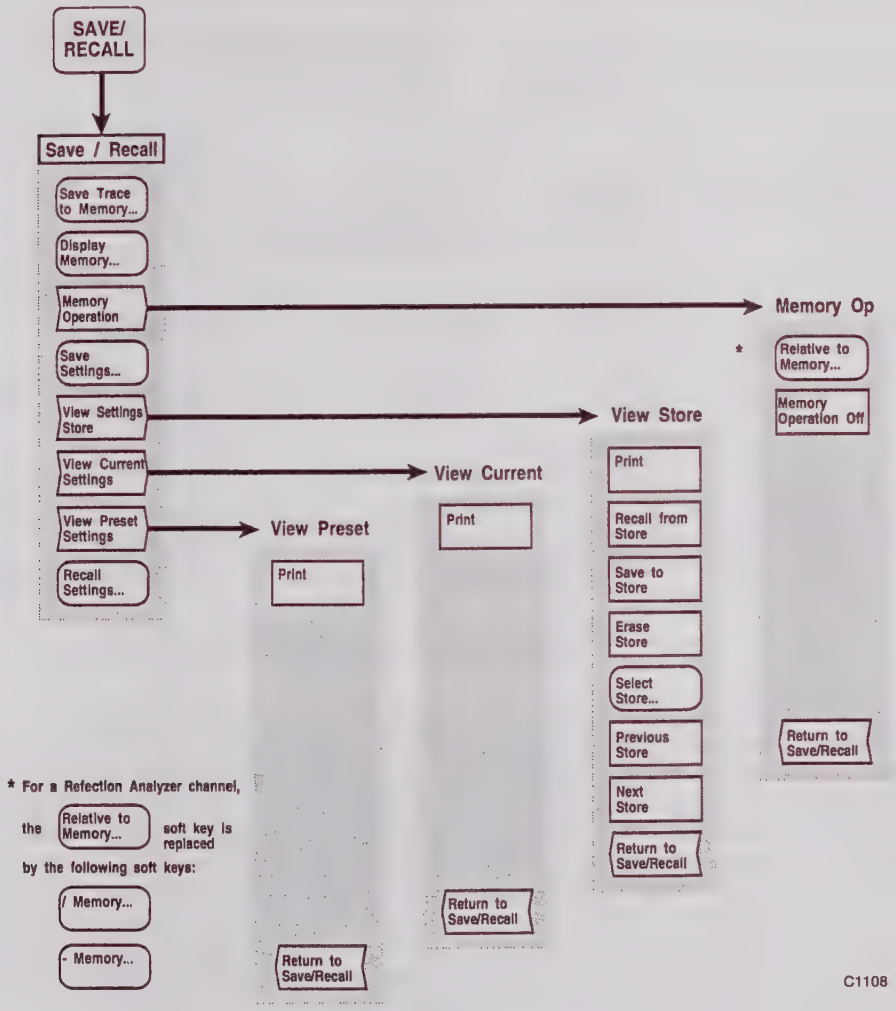


Fig. 3-66 SAVE/RECALL Menus

Save/Recall

The Save/Recall Menu enables the current instrument settings to be stored in a specified memory location in the internal non-volatile memory or on a memory card. Any of the stores can later be recalled in order to re-create the instrument state defined by the store contents. Facilities are available for viewing the stores without recalling them, and for obtaining a hard copy printout of the currently displayed store contents. Ten internal instrument settings stores are available. Measurement traces can be similarly stored, and subsequently recalled and/or used in relative measurements.

A typical settings store screen is shown in Fig. 3-67.

Instrument Settings Store 1		
Screen Title	:Microwave Test Set	
Channel Coupling	:Off	
	CHANNEL 1	CHANNEL 2
Channel Type	:Fault Location	Scalar
Domain	:Distance	Voltage
Start	:9.850198145 GHz	-10.00 V
Stop	:10.149801854 GHz	10.00 V
Output	:0.00 dBm	0.00 dBm
MEASUREMENT 1		
Meas Title	:Measurement 1	Measurement 3
Meas	:B/C	A
Format	:dB	dBm
Scale	:10.00 dB/	10.00 dB/
Ref Level	:0.00 dB	+20.00 dBm
MEASUREMENT 2		
Meas Title	:Measurement 2	Measurement 4
Meas	:M1	A
Format	:dB	dBm
Scale	:10.00 dB/	10.00 dB/
Ref Level	:0.00 dB	+20.00 dBm

C0428

Fig. 3-67 Example of Displayed Instrument Settings Store

Save Trace to Memory

Saves the currently active measurement, together with some of the instrument settings, in a memory location specified by the user. These settings are required in order that the instrument can recreate the channel and measurement set-up necessary to display the memory as it was originally stored. When this soft key is pressed, a form is displayed listing the identities and store numbers of the available memories. To save the data to a specific memory location, the memory identity number is entered in the input field. The store can be either an internal MTS store or a memory card. A text editor is then presented which enables the measurement title to be edited, if required.
This soft key is unselectable for a readout channel. For a fault location channel it is only selectable if measurement 1 is active.

Rotary Control ×	Step Keys ×	Numeric Pad √	Terminator	Any

Display Memory

Enables the measurement trace in a specified trace memory to be displayed. A fault location trace will be displayed as measurement 2 in the currently active fault location channel. When this soft key is pressed, a form is displayed indicating the range of available memories. To recall the trace in a specific memory location, the memory identity number is entered from the keyboard. Various instrument settings are saved together with the trace memory. When the memory is recalled, these saved settings may affect other measurements that are being displayed. The user is therefore given the choice of using either the saved settings or current settings.
This soft key is unselectable for a readout channel. For a fault location channel it is only selectable if measurement 2 is active.

Rotary Control	×	Step Keys	×	Numeric Pad	√	Terminator	Any

Memory Operation

Leads to the Memory Op Menu.
This soft key will only be selectable for a scalar channel, and if the currently defined trace is not a memory.
See page 3-244

Save Settings

Saves the current instrument settings to a specified store which can be eiher an internal MTS store or a memory card . When this soft key is pressed, a form is displayed on the screen indicating the range of available stores.

Rotary Control	×	Step Keys	×	Numeric Pad	√	Terminator	Any

View Settings Store

Leads to the View Store Menu, and enables the contents of instrument settings stores to be displayed.
See page 3-245.

View Current Settings

Displays the contents of the current instrument settings store. Pressing the *[Print]* soft key causes the information to be sent to printer; the printed format is the same as the displayed format.

View Preset Settings

As above but applies to the preset instrument settings.

Recall Settings

Recalls an instrument settings store by entering the required store identity number. This can refer to either an internal memory, or a store on a memory card. The instrument will be set up according to the stored parameters. Note that if a settings store stored on one instrument is recalled on another variant, the parameters being recalled will be clipped as necessary to match the hardware capability of that variant. If the instrument on which the settings are recalled does not have an appropriate adapter fitted (e.g. Reflection Analyzer), then a settings store containing a channel set-up that requires that adapter will not be recallable

Rotary Control	×	Step Keys	×	Numeric Pad	√	Terminator	Any

SAVE/RECALL

Memory Operation

Memory Op
(Scalar channel)

Enables the currently active measurement to be made relative to the measurement data in a specified trace memory. The measurement that is displayed is the ratio of the live trace to the stored trace for scalar measurements, and the difference between the live trace and the stored trace for frequency measurements.

For normal measurements, the domain range will be the same for both current and stored traces. Memory data will be interpolated to match a live measurement over a different start/stop range.

The memory operation applies per trace.

Relative to Memory

When this soft key is pressed, a form is displayed indicating the range of available memories. To select the memory to be used in the measurement, the memory identity number is entered from the keyboard.

Rotary Control ×	Step Keys ×	Numeric Pad √	Terminator	Any

Memory Operation Off

Turns off the memory operation.

Return to Save/Recall

Returns control to the Save/Recall Menu.

SAVE/RECALL

Memory Operation

Memory Op
(Reflection analyzer channel)

Enables the currently active measurement to be made relative to the measurement data in a specified trace memory.

The measurement that is displayed can be either the ratio of the live trace to the stored trace, or the difference between the live trace and the stored trace. Note that complex arithmetic is used since the quantities involved are complex.

The memory operation will not be permitted if the trace memory does not contain a reflection analyzer measurement, or if the settings displayed with the trace memory do not match those of the channel in which the live measurement is displayed.

/ Memory

Used to select a memory to divide the live measurement by. A form is displayed indicating the range of available memories, and the identity number of the required memory is entered from the keyboard.

Rotary Control ×	Step Keys ×	Numeric Pad √	Terminator	Any

- Memory

Used to select a memory to subtract from the live measurement. A form is displayed indicating the range of available memories, and the identity number of the required memory is entered from the keyboard.

Rotary Control	×	Step Keys	×	Numeric Pad	√	Terminator	Any

Memory Operation Off

Turns off the memory operation.

Return to Save/Recall

Returns control to the Save/Recall Menu.

SAVE/RECALL **View Settings Store**

View Store

This menu is used for save, recall, erase and print operations on instrument settings stores.

Print

Causes the currently displayed information to be sent to the printer; the printed format is the same as the displayed format.

Recall from Store

Applies the instrument settings from the store currently being viewed.

Save to Store

Saves the current instrument settings to the store currently being viewed. If the store already contains data, this will be overwritten, after asking for confirmation.

Erase Store

Erases the contents of the currently displayed store, after asking for confirmation.

Select Store

Enables an instrument settings store to be selected for viewing, by entering the required store identity number.

Rotary Control	×	Step Keys	×	Numeric Pad	√	Terminator	Any

Previous Store

Used to display the previous instrument settings store.

Next Store

Used to display the next instrument settings store.

Return to Save/Recall

Returns control to the Save/Recall Menu.

[MACRO] KEY

The [MACRO] key provides access to the series of menus illustrated in Figs. 3-68 to 3-71. The MTS Macro facility, in its simplest form, allows a sequence of front panel keypresses to be recorded as the instrument is operated. The macro can then be saved in the instrument's internal non-volatile memory, or on a memory card. The amount of memory available for macros is that left over after the card has been configured to provide stores of various kinds - see Config Card Menu. A descriptive label can be assigned to the macro as an aid to remembering its function. When a macro is *run,* the saved keypresses are "replayed", and the MTS obeys them as though they came from the keyboard.

Control and Condition Codes

To be useful, the macro function needs to do more than simply replay keypresses. It must be able to emulate the actions of an experienced user. A human operator would not, for example, set up a swept measurement and then immediately initiate a marker peak search without having first waited until a complete trace had been captured. To simulate waiting for measurement update, and other operator actions, *control codes* may be embedded between the keypresses as the macro is recorded. Loop and branch control codes also have *condition codes* associated with them. The effects of the various types of control and condition codes are summarised in the following tables.

CONTROL CODE	FUNCTION
<Pause for Measurement Update>	Macro execution pauses until all displayed measurements have updated. This control code may be inserted after a sequence of keypresses that causes measurements to restart - for example, changing the number of displayed channels.
<Pause for Averaging>	Pauses execution until the active measurement averaging has completed.
<Pause for Terminator>	Pauses execution until one of the four numeric entry terminator keys is pressed. This is particularly useful in conjunction with the Display Message control code.
<Pause for Print/Plot>	Pauses execution until a print or plot has completed.
<Accept Numeric Input>	This control code can be inserted following a keypress that enables numeric input. It allows numeric values to be passed into a function while a macro is executing. The macro resumes running when one of the terminator keys is pressed.
<Display Message>	A message of up to 5 lines of text is displayed in an automatically sized window. Messages may be used to give instructions to an operator. If the message is not removed before the macro terminates, it is erased when the next keypress is received.
<Remove Message>	Erases the message displayed by the Display Message control code.
<Run Macro>	Runs a macro from within a macro. This is a powerful facility for simplifying the creation of a complex macro by chaining a series of shorter, simpler macros together.
<Macro Time Delay> n	Delays macro execution for a specified time. The delay (n) can be from 10 ms to 1 hr.
<If...Then> [CONDITION] **<run macro> macro_1** **{<Else>** **<run macro> macro_2}** Items enclosed by { } are optional	On detecting the <If...Then> control code, the [CONDITION] is evaluated; if found to be true then macro_1 will be executed. If the condition is found to be false and there is no optional <Else> control code, then execution will continue with the next keypress or control code following the If...Then construct. If the condition evaluation is false and the <Else> control code is present, then macro_2 will be executed.
<Else>	The <Else> control code is optional to the <If...Then> and <Case> control codes

<Case> **[CONDITION 1]** **<run macro> macro_1** **{[CONDITION 2]** **<run macro> macro_2** . . **[CONDITION n]** **<run macro> macro_n** **<Else>** **<run macro> macro_m}** Items enclosed by { } are optional	On detecting the <Case> control code, [CONDITION 1] is evaluated; if found to be true then macro_1 will be executed. Execution of the main macro will then continue with the keypress or control code following the Case construct. If [CONDITION 1] is false then the next condition code is evaluated. This and subsequent condition codes are processed in a similar way. If found to be false, the macro proceeds to the next condition code; if true, the associated macro is executed and macro execution will then continue with the keypress or control code following the Case construct. If an <Else> is present and no conditions are true the macro_m will execute. Macro execution will then continue with the next keypress or control code following the case construct.
<Repeat...Until> [CONDITION] **<run macro> macro_1**	On detecting the <Repeat...Until> control code, macro_1 will be executed. The [CONDITION] will be evaluated and if found to be false then macro_1 will again be executed. If true, then execution will continue with the next keypress or control code following the Repeat...Until construct.
<While...Do> [CONDITION] **<run macro> macro_1**	On detecting the <While...Do> control code the [CONDITION] will be evaluated; if found to be true then macro_1 will be executed. If the condition is found to be false, then execution will continue with the next keypress or control code following the While...Do construct.
<For> n **<run macro> macro_1**	On detecting the <For> control code, macro_1 will be executed n times, where n is in the range 1 to 10^6.

CONDITION CODE	FUNCTION
[TRUE]	Always TRUE, i.e. the condition code evaluated will always be returned with a true value. This can be used to implement While... Do loops. It can be aborted using the [LOCAL] key.
[AVERAGING COMPLETE]	The condition is true if averaging has completed for the active measurement.
[LIMIT PASS]	The condition is true if the active measurement has passed the limit check (a limit check which is not applied to the active measurement is assumed to be a pass condition).
[LIMIT FAIL]	The condition is true if the active measurement has failed the limit check.
[MTS TYPE = 6200] [MTS TYPE = 6201] [MTS TYPE = 6203] [MTS TYPE = 6204]	The condition is true if the MTS on which the macro is running is that specified in the condition.
[70 dB STEP ATTENUATOR] [90 dB STEP ATTENUATOR]	The condition is true if the 70 dB step attenuator is present in the instrument. The condition is true if the 90 dB step attenuator is present in the instrument.
[REFLECTION ANALYZER]	The condition is true if the Reflection Analyzer is fitted to the MTS.
[STORES EXTENSION CARD] [TRANSMISSION LINE CARD] [APPLICATION CARD]	The condition is true if a memory card of the type specified has been inserted into the MTS.
[ANY IDENTIFIABLE CARD]	The condition is true if any of the above types of memory card has been inserted.
[MACRO] macro_name	The condition is true if a macro with the specified name is present (either in internal memory or on a memory card).
KEY=[keypress]	The condition is true if a particular front panel key has been pressed, as specified by [keypress]. This facility allows the user to interact with a running macro. All front panel keys are allowed except [LOCAL] and [PRESET]. For clarity, the condition code should be preceded by a display message stating which key to press. For the If...Then, Repeat...Until and While...Do conditions, the system will wait for a keypress. For the Case condition the system will wait for a keypress on the first occurrence of the condition code in the Case. Subsequent keypress condition codes will not wait but use the previously entered keypress.

Macro Status Messages

While a macro is being recorded, run or stepped, status messages are displayed in the position normally occupied by the screen title.

MESSAGE	WHEN DISPLAYED
Macro: Record [LOCAL] to Edit	Recording Macro
Macro: Run [LOCAL] to Abort	Running Macro
Macro: Step [LOCAL] to Abort	Stepping Macro
Macro: Paused for Measurement	Executing Pause for Measurement control code.
Macro: Paused for Averaging	Executing Pause for Averaging control code.
Macro: Numeric Entry Expected	Executing Pause for Numeric Entry control code.
Macro: Terminator Key Expected	Executing Pause for Terminator control code
Macro: Paused for Print / Plot	Executing Pause for Printing or Plotting.
Macro: Suspended [LOCAL] Abort	Executing Macro Time Delay.

Creating a Macro

Recording starts after selecting [MACRO] *[Start Recording]*. Each keypress, with the exception of [LOCAL] or [PRESET] is recorded in the macro. [PRESET] has its usual function, and any macro recording in progress at the time is aborted. [LOCAL] gives access to the macro editor, which provides functions to correct errors, to suspend recording temporarily and to insert control codes. Recording is stopped by selecting [MACRO] *[Stop Recording]*. This function allows the macro to be given a descriptive name and then stored in the MTS memory or a memory card.

Running or Stepping a Macro

A macro is run by selecting [MACRO] *[Run Macro]* and choosing the required macro from the list displayed. Alternatively, a macro can be stepped by selecting [MACRO]*[Step Macro]* In step mode, execution pauses after each keypress or control code until a keypress is received from the front panel. Stepping allows the operation of a macro to be observed in detail and can be useful for fault-finding. The [LOCAL] key may be used to abort a macro that is being run or stepped.

Macro Hints and Tips

Use Settings Stores

Although it is possible to use a macro to set up a particular instrument state - that is, a combination of settings, such as channel mode, measurement definitions, format and scaling parameters, this is better achieved using the save and recall settings functions - see Save/Recall Menu. The macro facility really comes into its own when it is used to automate *procedures*. For example, a macro could be written to measure the bandwidth of a bandpass filter at -3 dB and -60 dB, and automatically place markers at those points of interest. To do this, the set-up required to display the filter response can be saved in a settings store. A macro can then be written to recall the settings store, calibrate the measurement (using display message control codes to prompt the operator to make the necessary connections), and finally to position the markers.

Preset Settings Within a Macro

For technical reasons the [PRESET] key cannot be recorded as part of a macro. However, to set up the instrument to the preset state, press [PRESET], then save the default settings in a settings store. These may be recalled within the macro.

Minimise Text Entry

Text entered for display with the Display Message control code is not lost after the message is added to the macro. The next time the Display Message control code function is selected, the most recent message text is made available for editing. Since messages within a macro are often very similar, time can be saved by simply editing the previous message text rather than starting from scratch.

Correcting Errors While Recording - Use of Suspend & Resume Functions

Keypresses or control codes entered by mistake can be removed from the macro by entering the macro editor and using the *[Delete Last Entry]* function. Sometimes, however, this is not enough to correct the error. Suppose the [SWITCH CHANNEL] key is inadvertently pressed while recording a macro. The erroneous keypress can be removed by the editor *[Delete Last Entry]* function easily enough, but the effect that the keypress has had on the operation of the instrument has, of course, not been corrected; the wrong channel has been made active.

Problems like this can be corrected by using the *[Suspend Recording]* function available within the editor. With recording suspended, changes to the instrument settings caused by pressing the wrong key can be reversed. When this has been done, the [*Resume Recording*] function allows macro recording to continue.

Using the Main Macro Editor

Corrections can be made to a macro that has already been recorded and saved, using the macro editor accessed from the top level macro menu. This editor enables items to be added or deleted anywhere within the macro; it can also be used to create a new macro, but this is easier to achieve by recording keypresses.

Create a Library of Short Macros

It is good practice to break down complex procedures into a series of simpler tasks, and create a short macro for each one. The complex macro need only consist of a series of Run Macro control codes that run a selection of short macros from the "library".

Limitations

The maximum number of macros is 999 and the maximum length of a macro is 2048 bytes. Each key press, control code or character in a displayed message requires 1 byte. The maximum depth to which Run Macro control codes can be nested (i.e. macro calls a macro which calls another macro...etc) is 50.

Macro *See Fig. 3-68*

Run Macro

Used to run a macro contained in a specified macro store by entering the required store identity number. While a macro is running, the screen title is replaced by 'Macro: Run [LOCAL] to Abort'.

If a control code is encountered (see Add Code Menu, page 3-256) the screen title area will change to one of the following, as appropriate.

Macro: Paused for Measurement
Macro: Paused for Averaging
Macro: Numeric Entry Expected
Macro: Terminator Key Expected
Macro: Paused for Print / Plot
Macro: Suspended [LOCAL] Abort

A running macro can be aborted at any time by pressing the [LOCAL] key.

Rotary Control ×	Step Keys ×	Numeric Pad √	Terminator	Any

Step Macro

Pressing this soft key enable the user to step through a macro by pressing any front panel key. To load the required macro, its identity number is entered from the keyboard. While a macro is stepping, the screen title is replaced by 'Macro: Step [LOCAL] to Abort'.

If a control code is encountered, a message will be displayed, as above.

A stepping macro can be aborted at any time by pressing the [LOCAL] key.

Start Recording

Places the instrument into the macro recording mode in which subsequent keypresses (except [LOCAL] and [PRESET] will be recorded until the recording mode is exited. The maximum size of a macro is 2048 bytes. Each keypress or message character is one byte, but control codes can be more than one byte long. During macro recording, the screen title is replaced by 'Macro: Record [LOCAL] to Edit'.

Whilst in the recording mode, pressing [LOCAL] invokes the macro editor function (See Edit Macro Menu, page 3-255).

Once this soft key has been pressed, it is replaced by *[Stop Recording]*.

Stop Recording

Stops recording keypresses and presents the Save Macro Menu. The *[Stop Recording]* soft key appears in place of *[Start Recording]* once this soft key has been pressed.
See page 3-253.

Log Errors

Provides a method of logging the first three errors that occur during the execution of a macro. The log is cleared when a macro is run or single stepped; it is not cleared by the execution of a control code that causes another macro to run. When error logging is enabled and an error is logged, a message will be displayed at the end of macro execution informing the user that errors have occurred and to examine the error log.

View Error Log

Enables the contents of the error log to be examined. The *[Previous Error]* and *[Next Error]* soft keys are used to select the error that is displayed.

Copy Macro — Leads to the Copy Macro Menu
See page 3-254

Edit Macro — Leads to the Edit Macro Menu.
See page 3-258

Delete Macro — Leads to the Delete Macro Menu.
See page 3-254 .

MACRO → **Stop Recording**

Save Macro — ***See Fig. 3-68.*** **This menu is used to save a macro following completion of macro recording.**

Save to MTS Memory — Saves the macro that has just been recorded into MTS non-volatile memory. A form is displayed showing the available memory and the size of the macro to be saved. Any number of macros up to 999 can be stored subject to available memory. This function automatically brings up the Macro Id Menu which allows a title to be entered. The method of entry is the same as that described for the Screen Title Menu. Pressing *[Done]* saves the macro to memory.
This soft key will be unselectable if there is insufficient memory to save the macro.

Save to Card — Saves the macro that has just been recorded onto a memory card. A form is displayed showing the available memory and the size of the macro to be saved. Any number of macros up to 999 can be stored subject to available memory. This function automatically brings up the Macro Id Menu which allows a title to be entered. Pressing *[Done]* saves the macro to memory.
This soft key will be unselectable if there is insufficient memory available or if no memory card is present.

Delete Macro — Leads to the Delete Macro Menu, which can be used to create more space, if required.
See page 3-254.

Abort — Terminates the function without performing a save, after prompting for confirmation.

MACRO

Copy Macro

Copy Macro

See Fig. 3-68. **This menu is used to copy a macro stored in the MTS to a memory card, or vice versa.**

Copy Macro to Card

Enables copying of a macro stored in the MTS to a memory card. A form is displayed listing the macros present in memory and the amount of memory available on the card for macro storage. The macro will be copied when the required identity number is entered from the keyboard. The macro will not be copied if there is not enough storage capacity on the card. The *[Delete Macro]* soft key (Macro Menu) can be used to create more space on the card, if required.

Rotary Control ×	Step Keys ×	Numeric Pad √	Terminator	Any

Copy Macro from Card

As above, but copies a macro from a memory card to non-volatile RAM in the MTS.

Return to Macro

Returns control to the Macro Menu.

MACRO

Delete Macro

Delete Macro

See Fig. 3-68. **This menu enables the deletion of a range of macros from either the MTS or a memory card.**

A form is displayed listing the macros present in the MTS and on the card, and their sizes in bytes. A range of macros can be deleted by entering a 'from' and a 'to' macro identity number. The macros are deleted when the *[Delete]* soft key is pressed. Only the 'from' macro identity needs to be entered if a single macro is to be deleted. The delete function is confirmation protected.

From Macro

Used to enter the identity of the first macro of a range of macros to be deleted.

To Macro

Used to enter the identity of the last macro of a range of macros to be deleted.

Page Up

Displays the next page of the macro list.

Page down

Displays the previous page of the macro list.

Delete

Deletes the macros in the specified range and returns control to the Macro Menu.

Edit Macro

See Fig. 3-69. **This menu is used to correct errors made during keystroke recording and allows special control codes to be inserted in the macro.**

This menu is accessed by pressing the [LOCAL] key whilst in the recording mode.

(To edit existing macros, i.e. stored in memory, the macro editor accessed from the top level menu is used.)

Delete Last Entry

Deletes the last keystroke or control code (i.e. the last entry in the macro buffer).
This soft key is unselectable if there are no entries in the macro buffer.

Add Control Codes

Leads to the Add Code Menu.
This soft key is unselectable if the macro buffer is full.
See page 3-256

Suspend Recording

Suspends recording of the macro and allows the user to return to normal menu operation by pressing the *[Exit Macro Editor]* soft key. This allows the user to return to the required point within the menu structure and to continue recording using the *[Resume Recording]* soft key.
This soft key is unselectable if recording has already been suspended.

Resume Recording

Allows the user to continue recording keystrokes after suspending recording with the above soft key.
This soft key becomes unselectable when recording has been resumed.

Exit Macro Editor

Exits the Edit Macro Menu and allows macro recording to resume.

Add Code

See Fig. 3-69. **This menu enables control codes to be inserted in the macro. They are used to pause execution until certain actions have occurred, add loop and branch conditions, specify further macros that are to be run, or to display messages specified by the user.**

When entering control codes, certain soft keys may become unselectable to prevent the introduction of syntax errors. For example, only Condition codes, Run Macro codes and Else codes are allowed within a Case construct; all other soft keys are unselectable. A description of the control codes and their usage is given at the start of the Macro Key description.

All soft key except *[Return to Macro Editor]* are unselectable if the macro buffer is full

Pause — Leads to the Pause Menu.
See page 3-257.

Loop & Branch — Leads to the Loop & Branch Menu.
See page 3-262

Accept Numeric Input — Pauses execution until a terminator key is pressed

Accept Numeric Input — Accepts numeric entry (either keyboard, rotary control or step keys) until a terminator is received.

Display Message — Leads to the Disp Message Menu.
See page 3-257.

Remove Message — Removes the message that is currently being displayed.

Run Macro — Leads to the Run Macro Menu.
See page 3-258.

Set Time Delay — Used to suspend macro execution for a specified period of time, by entering the required time delay. Delays between 10 ms and 1 hr can be entered. If the time delay is greater than 1 s, an appropriate message is displayed while the macro is suspended.

Rotary Control ×	Step Keys ×	Numeric Pad √	Terminator	10^+

Return to Macro Editor — Returns control to the Edit Macro Menu.

MACRO → Start Recording • • • → LOCAL → Add Control Codes → Pause

Pause

See Fig. 3-69. **This menu is used to insert control codes in a macro which are used to pause execution until certain actions have occurred.**

Pause for Meas Update — Pauses execution until measurement update has completed.

Pause for Averaging — Pauses execution until the averaging target value has been reached for the active trace.

Pause for Terminator — Pauses execution until a terminator key is pressed.

Pause for Print / Plot — Pauses execution until printing or plotting has completed.

Return to Add Code — Returns control to the Add Code Menu.

MACRO → Start Recording • • • • • → LOCAL → Add Control Codes → Display Message

Disp Message

See Fig. 3-69. **This menu allows a message of up to five lines to be displayed on the screen. Each line can be up to 50 characters in length.**

Set Line 1 — Enables the entry of a text string as line 1 of the displayed message. The method of entry is the same as that described for the Screen Title Menu (page 3-276).

Set Line 2 — As above, but for line 2 of the message.

Set Line 3 — As above, but for line 3 of the message.

Set Line 4 — As above, but for line 4 of the message..

Set Line 5 — As above, but for line 5 of the message.

Return to Add Code — Returns control to the Add Code Menu.

MACRO | Start Recording | • • • | LOCAL | Add Control Codes | Run Macro

Run Macro

See Fig. 3-69. **This menu is used to insert a Run Macro control code. When this control code is encountered another macro beings running at this point; when it terminates, the calling macro resumes operation. The macro that is to be run can be selected from a list of stored macros that is displayed, or its name can be entered directly.**

Enter Macro By Number

When this soft key is pressed, a form is displayed listing the available macros. A sub-menu is presented with two soft keys, *[Page Up]* and *[Page Down]*; these are used to select pages if there is more than one. The macro to be run is selected by entering the appropriate store number.

Enter Macro By Name

When this soft key is pressed, a form is displayed allowing the name of the required macro to be entered. The method of entry is the same as that described for the Screen Title Menu (page 3-276).

Return to Add Code

Returns control to the Add Code Menu.

MACRO | Edit Macro

Edit Macro

See Fig. 3-70. **This menu provides access to the macro editor, which is used to edit existing macros or to create a new one.**

Edit Macro By Number

When this soft key is pressed, a form is displayed listing the available macros. To select a macro for editing, the macro store number is entered from the keyboard. Control is then passed to the next level of the Edit Macro function (page 3-259).

Edit Macro By Name

When this soft key is pressed, a form is displayed allowing the name of a macro to be entered. The method of entry is the same as that described for the Screen Title Menu (page 3-276). Control is then passed to the next level of the Edit Macro function (page 3-259).

Edit New Macro

Leads directly to the next level of the Edit Macro function, without requesting for the identity of a macro.
See page 3-259.

Exit Edit

Exits the macro editor and returns control to the Macro Menu.

Edit Macro

See Fig. 3-70. **This menu follows on from the previous Edit Macro Menu, and provides functions for editing, printing and saving macros.**

Edit

Leads to the Edit Menu.
See page 3-260.

Print Macro

Enables the macro currently being edited to be printed
This soft key will be unselectable if the contents of a macro have been deleted, and will initially be unselectable if a new macro is being created.

Save Macro

Leads to the Save Macro Menu. When this soft key is pressed, a syntax check is performed on the macro. If there are any errors an explanatory warning message will be displayed; any errors must be rectified using the Edit Menu before the save will be permitted.
This soft key will be unselectable if the contents of a macro have been deleted, and will initially be unselectable if a new macro is being created.
See page 3-261.

Save as New Macro

Leads to the Save Macro Menu. When this soft key is pressed, a syntax check is performed on the macro. If there are any errors an explanatory warning message will be displayed; any errors must be rectified using the Edit Menu before the save will be permitted.
This soft key will be unselectable if the contents of a macro have been deleted, and will initially be unselectable if a new macro is being created.
See page 3-261.

Exit

Returns control to the previous Edit Macro Menu. Before doing so, a syntax check is performed on the macro. If there are any errors an explanatory warning message will be displayed; any errors must be rectified using the Edit Menu before the exit will be permitted.

Edit

See Fig. 3-70. **This menu enables front panel keys and control codes to be added to a macro, and macro items to be deleted.**

The current edit position is indicated by a box surrounding the macro item. This can be moved around the macro by using the *[⇑]*, *[⇓]*, *[Page Up]* and *[Page Down]* soft keys. If a new macro is being created, the cursor box will not appear until an item has been added.

Add Keys

Allows front panel keys to be added to a macro. All front panel keys are allowed except [LOCAL] and [PRESET]. Hard keys are added by pressing the appropriate key. If a soft key is added, its function depends on the menu that would result from the keypresses previously entered into the macro. Pressing the [LOCAL] key exits from this function.
This soft key will be unselectable if the current edit position lies within a Case construct.

Add Code

Leads to the Add Code Menu.
See page 3-256

Delete Entry

Used to delete the macro item at the current edit position, as identified by the cursor box surrounding the item. If the cursor box is on the 'Case' macro item, the whole Case construct will be deleted.
This soft key becomes unselectable when there are no more items in the macro.

⇑

Selects the previous item in the macro.

⇓

Selects the next item in the macro.

Page Up

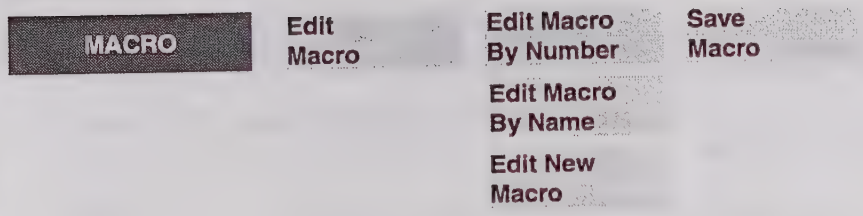
The previous page of the macro will be displayed.

Page Down

The next page of the macro will be displayed.

Return to Edit Macro

Returns control to the Edit Macro Menu.



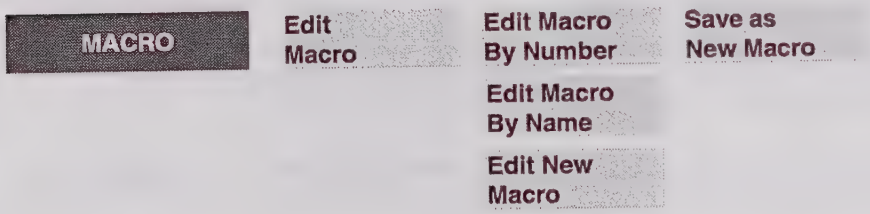
Save Macro — *See page 3-70.* **This menu is used to save the macro currently being edited.**

Save — Saves the edited macro to its previous location and with the same identity. If the identity is to be changed, this can be done with the *[Change Identity]* soft key.
This soft key will be unselectable if there is insufficient memory to save the macro, or if a memory card needs to be inserted.

Change Identity — This soft key brings up the Macro ID Menu, which allows the macro identity to be edited. Pressing *[Done]* returns to this menu; *[Save]* then saves the macro to memory under the new identity.

Delete Macro — Leads to the Delete Macro Menu, which can be used to create more space, if required. See page 3-254.

Return to Edit Macro — Returns control to the Edit Macro Menu.



Save Macro — *See page 3-70.* **This menu is used to save a macro that has just been created, or to save an edited macro as a new macro.**

Save to MTS Memory — Saves the macro that has just been created or edited into MTS non-volatile memory. A form is displayed showing the available memory and the size of the macro to be saved. Any number of macros up to 999 can be stored subject to available memory. This function automatically brings up the Macro Id Menu which allows a title to be entered. Pressing *[Done]* saves the macro to memory.
This soft key will be unselectable if there is insufficient memory to save the macro.

Save to Card — Saves the macro that has just been created or edited onto a memory card. A form is displayed showing the available memory and the size of the macro to be saved. Any number of macros up to 999 can be stored subject to available memory. This function automatically brings up the Macro Id Menu which allows a title to be entered. Pressing *[Done]* saves the macro to memory.
This soft key will be unselectable if there is insufficient memory available or if no memory card is present.

Delete Macro — Leads to the Delete Macro Menu, which can be used to create more space, if required. *See page 3-254.*

Return to Edit Macro — Returns control to the Edit Macro Menu.

Loop & Branch

See Fig. 3-71. **This menu allows a macro to be run using the programming constructs of a high-level language.**

The available constructs for looping/branching are:

If...Then
Repeat...Until
While...Do
Case
For

The loop/branch control code is followed by a Condition code and then a Run Macro control code. The Condition code is the item that enables looping or branching, according to whether the condition is evaluated as true or false. A full description of the condition code soft keys and there usage is given in 'Control and Condition Codes' at the start of the Macro key description.

After a *[For], [Else]* or a condition code soft key has been pressed, the Run Macro menu will be presented, which enables selection of the macro that is to be run at this point. When a macro has been selected, control returns to the Add Code Menu.

If...Then Enters the <If...Then> control code into the macro, then presents the Conditions Menu (page 3-263).

Else Enters an <Else> control code, which is associated with the <If...Then> control code. *During macro recording this soft key is only selectable after [If...Then] has been pressed; once [Else] has been pressed it becomes unselectable again.*

Repeat...Until Enters the <Repeat...Until> control code into the macro, then presents the Conditions Menu (page 3-263).

While...Do Enters the <While...Do> control code into the macro, then presents the Conditions Menu (page 3-263).

For Enters the <For> control code into the macro. The user then enters the number of times that a macro is to be run. The user is then presented with the Run Macro menu.

Case Leads to the Case Menu.
See page 3-263.

Return to Add Code Returns control to the Add Code Menu.

MACRO | Start Recording | • • • | LOCAL | Add Control Codes | Loop & Branch

Case

Case

See Fig. 3-71 . **This menu is used to enter control and condition codes for the Case construct.**

Case Conditions

Leads to the Conditions Menu.
See below.

Else

Enters an <Else> control code, which is associated with the <Case> control code.
During macro recording this soft key is only selectable after [Case] has been pressed; once [Else] has been pressed it becomes unselectable again.

Return to Loop Branch

Returns control to the Loop & Branch Menu.

MACRO | Start Recording | • • • | LOCAL | Add Control Codes | Loop & Branch

LOOP / BRANCH SOFT KEY | Conditions

Conditions

See Fig. 3-71. This menu is used to specify the conditions that determine looping or branching in the If...Then, Repeat...Until, While...Do and Case constructs.

The conditions are selected using this menu and the subsequent sub-menus. The soft keys are not described here, since a full description of the condition codes and there usage has been given in 'Control and Condition Codes' at the start of the Macro key description.

After a *[For], [Else]* or a condition code soft key has been pressed, the Run Macro menu will be presented, which enables selection of the macro that is to be run at this point. When a macro has been selected, control returns to the Add Code Menu.

Fig. 3-68 MACRO Menu (Sheet 1)

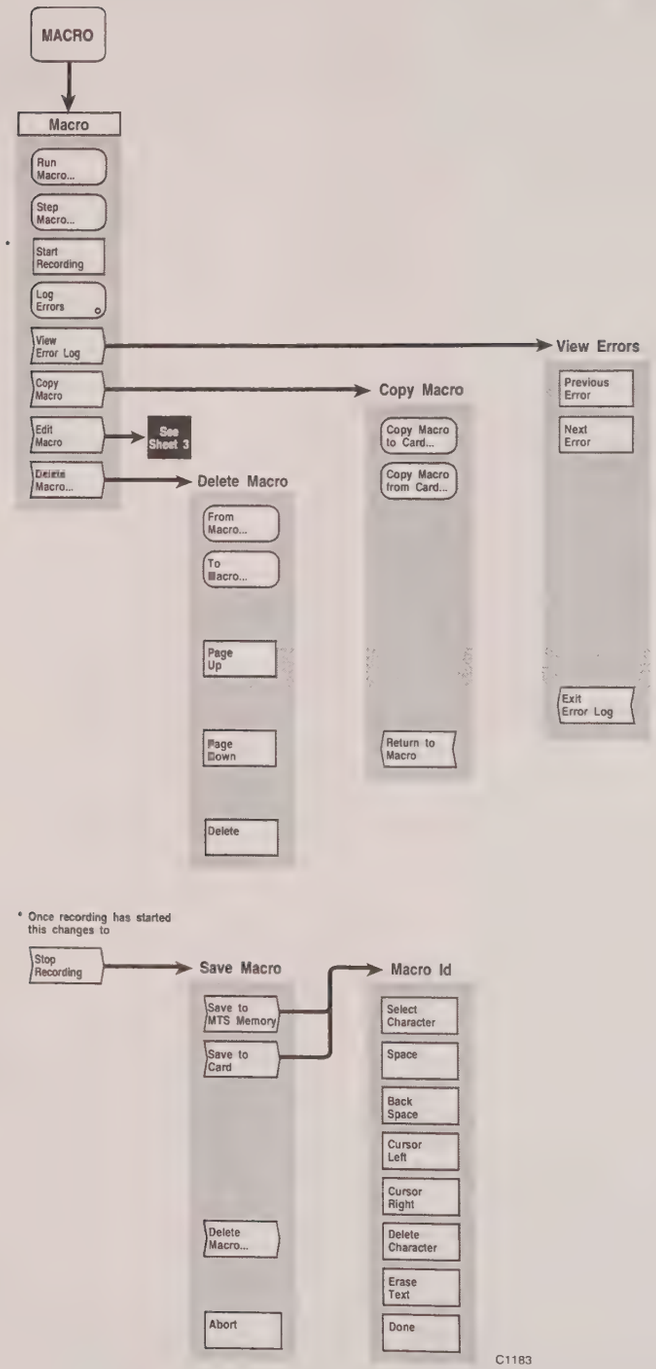


Fig. 3-68 MACRO Menu (Sheet 1)

Fig. 3-69 MACRO Menu (Sheet 2)

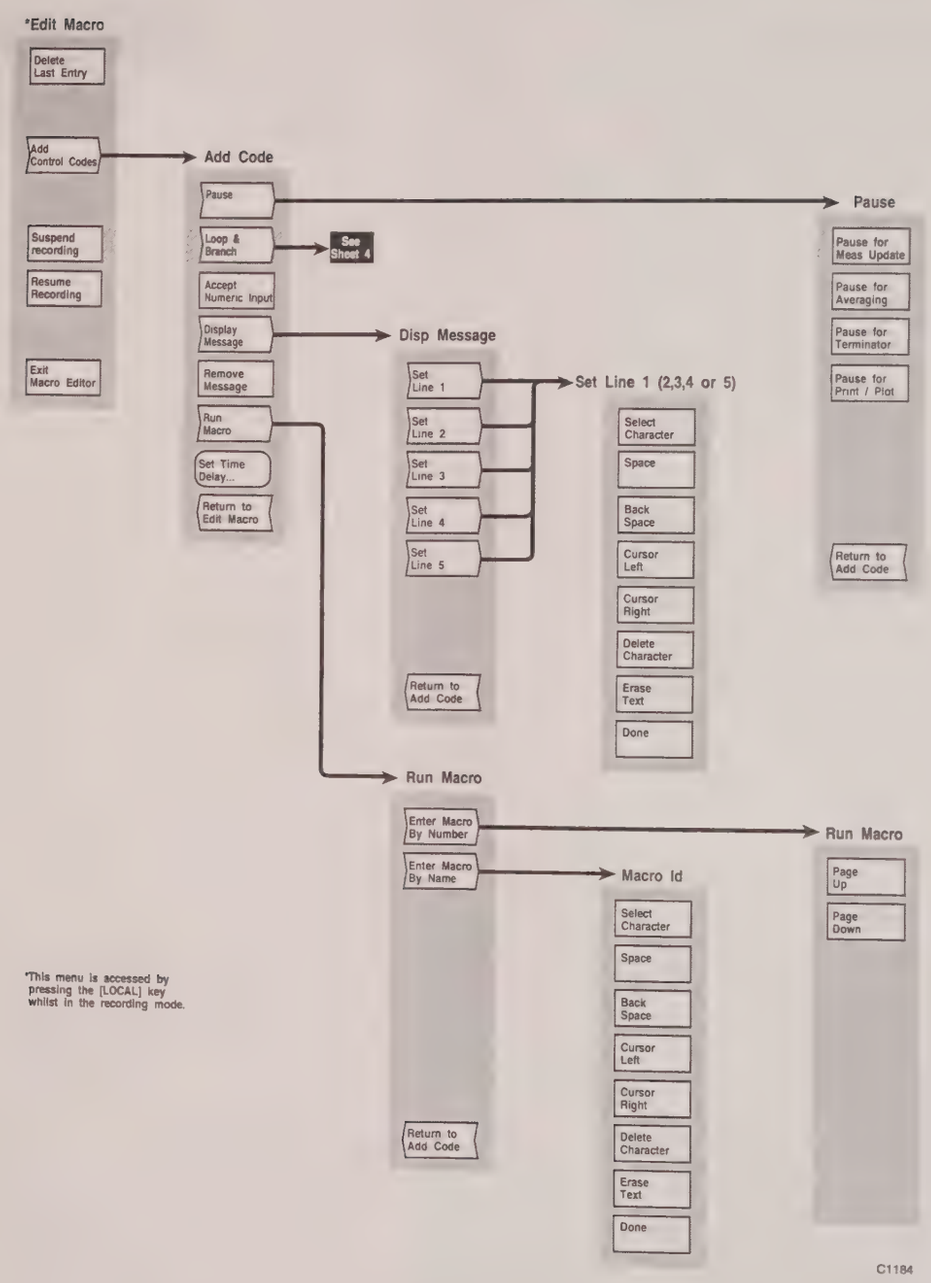


Fig. 3-69 MACRO Menu (Sheet 2)

Fig. 3-70 MACRO Menu (Sheet 3)

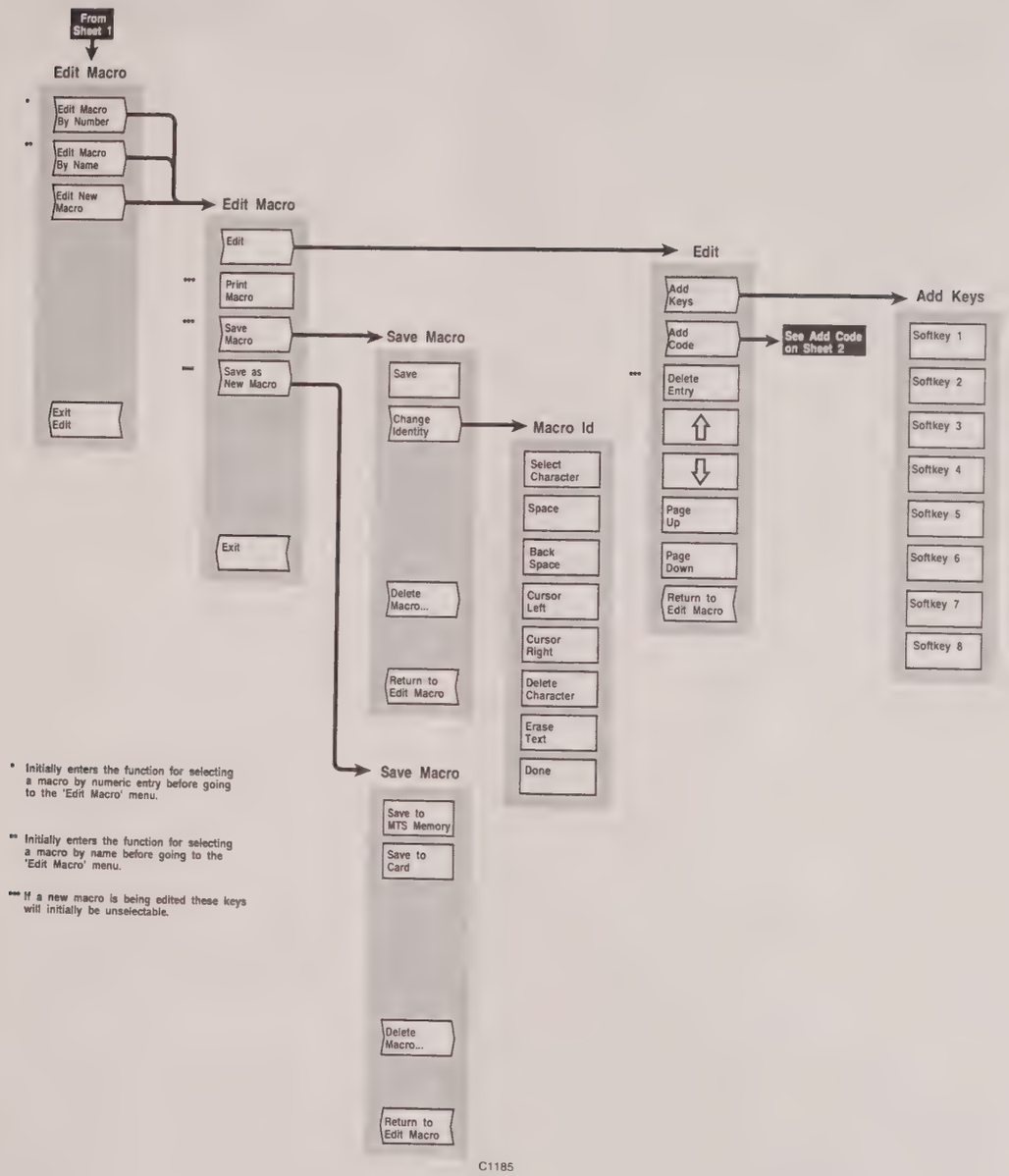


Fig. 3-70 MACRO Menu (Sheet 3)

Fig. 3-71 MACRO Menu (Sheet 4)

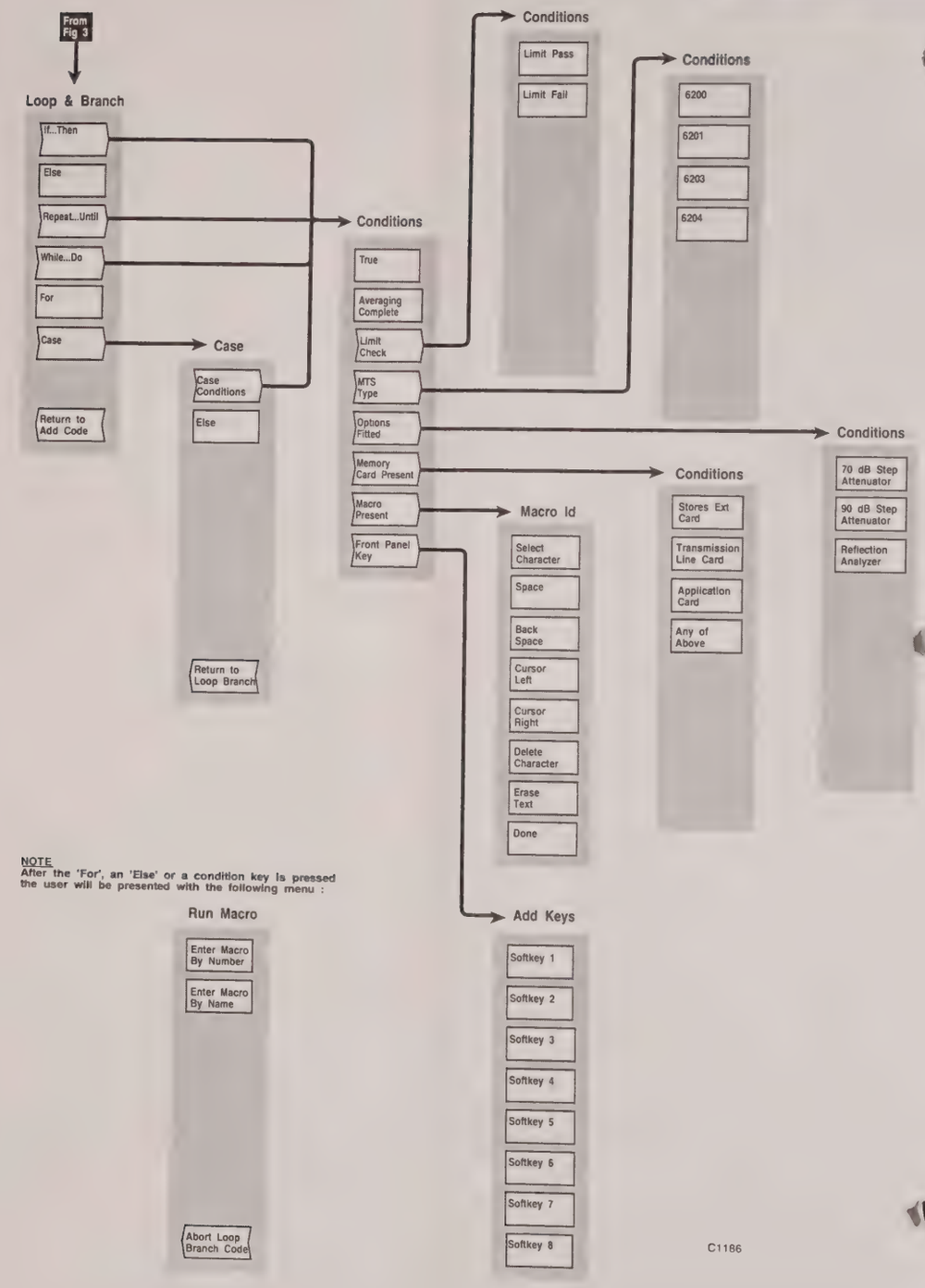


Fig. 3-71 MACRO Menu (Sheet 4)

[UTILITY] KEY

The [UTILITY] key provides access to the series of menus illustrated in Figs. 3-76 to 3-81. The menus provide utility functions, such as setting up GPIB addresses, generating titles, setting up the display, and performing various system functions.

UTILITY

Utility — *See Fig. 3-76.* **All the soft keys in this menu lead to further menus which provide utility functions not directly concerned with the measurement.**

GPIB — Leads to the GPIB Menu, which enables the instrument to be set up for GPIB operation.
See page 3-274.

Titles — Leads to the Titles Menu, which enables the main screen title and measurement titles to be entered and displayed.
See page 3-275.

Display Set-up — Leads to the Display Set-up Menu, which enables the display brightness to be set, and also provides a screen blanking facility. This menu also provides access to the "Secret Freq Display" function.
See page 3-277.

Set Inc / Dec Steps — Leads to the Inc/Dec Steps Menu, which enables the user to define the step size that is used when changing numeric parameters with the step keys and rotary control.
See page 3-278.

Store Operations — Leads to the Store Ops Menu, which enables the contents of a selected store to be copied to another.
See page 3-280.

Service — Leads to the Service Menu, which enables various system functions to be carried out, such as instrument tests, diagnostics and calibration, and setting up the instrument according to the user's requirements.
See page 3-284.

Applications — Leads to the Applications Menu, which enables the user to run an application program stored on a memory card.
See page 3-311.

GPIB

See Fig. 3-76. **This menu enables the GPIB mode to be selected, and the GPIB addresses for the MTS, external source and plotter to be set up. GPIB operation is covered in detail in the GPIB Operating Manual.**

Instrument Address

Enables the GPIB address for the MTS to be set up by entering a number between 0 and 30.

Rotary Control	×	Step Keys	×	Numeric Pad	√	Terminator	Any

Ext Source Address

Enables the GPIB address for the external source to be set up by entering a number between 0 and 30.

Rotary Control	×	Step Keys	×	Numeric Pad	√	Terminator	Any

Plotter Address

Enables the GPIB address for the plotter to be set up by entering a number between 0 and 30.

Rotary Control	×	Step Keys	×	Numeric Pad	√	Terminator	Any

Controller Mode

Puts the MTS in the Controller mode, in which the instrument acts as controller of the GPIB system. In this mode, the instrument can control a second MTS or an HPGL plotter.

Talk / Listen Mode

Puts the MTS in the Talk/Listen mode, in which the instrument behaves like a device conforming to IEEE 488.2, under the control of an external controller (which can be another MTS).

Restore Autotrigger

Returns the instrument to auto-trigger mode if a GPIB program leaves it in remote trigger mode.

Return to Utility

Returns control to the Utility Menu.

Titles

See Fig. 3-76. **This menu allows the user to generate the main screen title and also titles for both measurements on Channels 1 and 2.**

Set Screen Title
Leads to the Screen Title Menu.
See page 3-276.

Screen Title
Toggles the screen title on or off.

Channel 1 Meas Titles
Leads to the Chan 1 Titles Menu.
See page 3-277.

Channel 2 Meas Titles
Leads to the Chan 2 Titles Menu.
See page 3-277.

Return to Utility
Returns control to the Utility Menu.

Screen Title

See Fig. 3-76. **Enables a title to be entered which will be displayed at the top left of the screen. A form is displayed on the screen containing the current screen title in an input field and three rows of characters arranged as follows:**

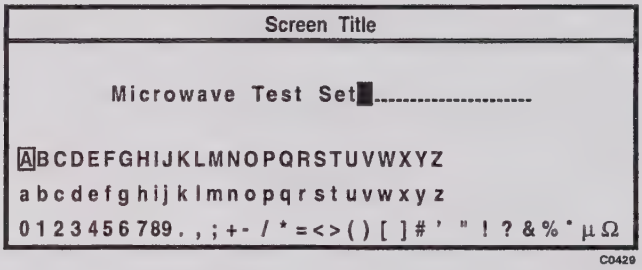


Fig. 3-72 Editing a Screen Title

The character that is to be selected is enclosed by a box which can be moved along the rows of characters using the rotary control. The step keys are used to select the row of characters (upper case, lower case or digits/symbols). Note that the front panel keys 0 to 9, "." and "-" can be used directly.

Select Character Causes the selected character to be added to the title at the cursor position.

Space Causes a space character to be added to the title at the cursor position.

Back Space Causes the character before the cursor to be deleted from the title.

Cursor Left Moves the cursor left one character.

Cursor Right Moves the cursor right one character.

Delete Character Deletes the character at the cursor position.

Erase Text Causes the entire text to be deleted from the input field.

Done Terminates screen title entry.

UTILITY → **Titles** → **Channel 1 Meas Titles**

Chan 1 Titles

See Fig. 3-76. **This menu is used to enter titles for measurement 1 and measurement 2 of channel 1, using the same procedure as for the screen title (see above).**

Set Meas 1 Title

Leads to a sub-menu which is used to enter a title for measurement 1. The procedure and soft keys are the same as for the Screen Title Menu.
See page 3-276.

Meas 1 Title

Toggles measurement 1 title on or off.

Set Meas 2 Title

Leads to a sub-menu which is used to enter a title for measurement 2. The procedure and soft keys are the same as for the Screen Title Menu.
See page 3-276.

Meas 2 Title

Toggles measurement 2 title on or off.

Return to Titles

Returns control to the Titles Menu.

UTILITY → **Titles** → **Channel 2 Meas Titles**

Chan 2 Titles

See Fig. 3-76. **This menu is the same as the Channel 1 Titles Menu, but applies to channel 2.**

UTILITY → **Display Set-up**

Display Set-up

See Fig. 3-76. **This menu provides soft keys for the following display functions:**

Secret Freq Display

Used to remove all frequency annotation from the display. The soft key has an on/off toggle action.

Screen Timeout

Sets the screen timeout value for the LCD. The LCD backlight will be automatically turned off after the timeout period has expired. Values in the range 1 to 999 minutes can be set; the default is 20 minutes. The display will be restored and the timeout counter reset when any key is pressed or the rotary control moved.

Rotary Control √	Step Keys √	Numeric Pad √	Terminator Any

Screen Brightness

Enables the LCD backlight to be switched between full and half brightness (the default is full brightness). When this soft key is pressed, a sub-menu is displayed; the LCD brightness is selected by pressing either the *[Full Brightness]* or *[Half Brightness]* soft key.

Lock Instrument

Used to blank the display and disable the front panel keys and GPIB. When this soft key is pressed, a 9 digit security password must be entered and then verified. The instrument remains locked until the security password is entered again, even if the instrument is switched off then on again.

Return to Utility

Returns control to the Utility Menu.

Inc/Dec Steps

See Fig. 3-76. **This menu enables the user to define the step size that is used when changing numeric parameters with the step keys and rotary control. Pressing one of the soft keys in this menu allows the step size for the indicated parameter to be changed by entering the new value.**

Set dB Step

Enables the dB step size to be changed.

Rotary Control	×	Step Keys	×	Numeric Pad	√	Terminator	Any

Set Freq Step

Enables the Frequency step size to be changed.

Rotary Control	×	Step Keys	×	Numeric Pad	√	Terminator	10+

Set Watts Step

Enables the Watts step size to be changed

Rotary Control	×	Step Keys	×	Numeric Pad	√	Terminator	10–

Set Voltage Step

Enables the Voltage step size to be changed.

Rotary Control	×	Step Keys	×	Numeric Pad	√	Terminator	10–

Set Current Step

Enables the Current step size to be changed.

Rotary Control	×	Step Keys	×	Numeric Pad	√	Terminator	10–

Set Units Step

Enables the Units step size to be changed.

Rotary Control	×	Step Keys	×	Numeric Pad	√	Terminator	10–

More

Leads to the Inc/Dec Steps (More) Menu.

Return to Utility

Returns control to the Utility Menu.

Inc/Dec Steps (More)

See Fig. 3-76. **This menu is a continuation of the Set Inc/Dec Steps Menu.**

Set % Step

Enables the Percentage step size to be changed.

Rotary Control	×	Step Keys	×	Numeric Pad	√	Terminator	Any

Set Distance Step

Enables the Distance step size to be changed.

Rotary Control	×	Step Keys	×	Numeric Pad	√	Terminator	10+

Set Time Step

Enables the Time step size to be changed.

Rotary Control	×	Step Keys	×	Numeric Pad	√	Terminator	10–

Return to Prior Menu

Returns control to the Inc/Dec Steps Menu.

Store Ops

See Fig. 3-77. **This menu enables copying of data held in a store to another store of the same type. The main purpose of this facility is to copy data to and from stores held on a memory card that has been inserted into the memory card slot in the front panel.**

If the memory card has been configured to provide stores extensions, the MTS will automatically recognise that additional stores are present, and are referenced by store numbers that follow on from those used to select the built-in stores of the basic instrument. Stores located on the memory card are manipulated identically to the internal resident stores. When the MTS prompts for a store number, the current range of available store numbers will be displayed, distinguishing between the internal stores and those on the card.

For information on configuring memory cards, refer to the menu accessed using [UTILITY]*[Service][Set-Up]*.

The soft keys provide a copy facility for the four types of store that can be located on a memory card.

Copy Inst Settings
Leads to the Inst Settings Menu.
See page 3-281.

Copy Trace Memory
Leads to the Trace Memory Menu.
See page 3-281.

Copy Sensor Cal
Leads to the Sensor Cal Menu.
See page 3-282.

Copy Source Power Cal
Leads to the Src Pwr Cal Menu.
See page 3-282.

Copy Reflect Analyzer Cal
Leads to the Reflect Cal Menu.
This soft key will only be displayed if the 6210 Reflection Analyzer is connected.
See page 3-283.

Copy Reflect Cal Kit
Leads to the Cal Kit Menu..
This soft key will only be displayed if the 6210 Reflection Analyzer is connected.
See page 3-283.

Erase All Stores
Erases the contents of all the above stores. This function is Level 1 Password protected.

Return to Utility
Returns control to the Utility Menu.

UTILITY | Store Operations | Copy Inst Settings

Inst Settings — *See Fig. 3-77.* **This menu is used to copy the contents of one Instrument Settings store to another.**

From Inst Settings — Used to select the settings store to copy from by entering the store identity number.

Rotary Control ×	Step Keys ×	Numeric Pad √	Terminator	Any

To Inst Settings — Used to select the settings store that is to be copied to by entering the store identity number.

Rotary Control ×	Step Keys ×	Numeric Pad √	Terminator	Any

Copy — Copies the store contents and terminates the function.

UTILITY | Store Operations | Copy Trace Memory

Trace Memory — *See Fig. 3-77.* **This menu is used to copy the contents of one trace memory to another.**

From Trace Memory — Used to select the trace memory to copy from by entering the memory identity number.

Rotary Control ×	Step Keys ×	Numeric Pad √	Terminator	Any

To Trace Memory — Used to select the trace memory that is to be copied to by entering the memory identity number.

Rotary Control ×	Step Keys ×	Numeric Pad √	Terminator	Any

Copy — Copies the trace memory and terminates the function.

UTILITY | Store Operations | Copy Sensor Cal

Sensor Cal

See Fig. 3-77. **This menu is used to copy the contents of one sensor calibration store to another.**

From Sensor Cal

Used to select the sensor cal store to copy from store by entering the store identity number.

Rotary Control ×	Step Keys ×	Numeric Pad √	Terminator Any

To Sensor Cal

Used to select the sensor cal store that is to be copied to by entering the store identity number.

Rotary Control ×	Step Keys ×	Numeric Pad √	Terminator Any

Copy

Copies the store contents and terminates the function.

UTILITY | Store Operations | Copy Source Power Cal

Src Pwr Cal

See Fig. 3-77. **This menu is used to copy the contents of one source power calibration store to another.**

From Source Power Cal

Used to select the source power cal store to be copied from by entering the store identity number.

Rotary Control ×	Step Keys ×	Numeric Pad √	Terminator Any

To Source Power Cal

Used to select the source power cal store that is to be copied to by entering the store identity number.

Rotary Control ×	Step Keys ×	Numeric Pad √	Terminator Any

Copy

Copies the store contents and terminates the function.

UTILITY | Store Operations | Copy Reflect Analyzer Cal

Reflect Cal

See Fig. 3-77. **This menu is used to copy the contents of one reflection analyzer calibration store to another.**

From Reflect Cal

Used to select the reflection analyzer cal store to be copied from by entering the store identity number.

Rotary Control	×	Step Keys	×	Numeric Pad	√	Terminator	Any

To Reflect Cal

Used to select the reflection analyzer cal store to be copied to by entering the store identity number.

Rotary Control	×	Step Keys	×	Numeric Pad	√	Terminator	Any

Copy

Copies the store contents and terminates the function.

UTILITY | Store Operations | Copy Reflect Cal Kit

Cal Kit

See Fig. 3-77. **This menu is used to copy the contents of one cal kit store to another.**

From Cal Kit

Used to select the cal kit store to be copied from by entering the store identity number.

Rotary Control	×	Step Keys	×	Numeric Pad	√	Terminator	Any

To Cal Kit

Used to select the cal kit store that isto be copied to by entering the store identity number.

Rotary Control	×	Step Keys	×	Numeric Pad	√	Terminator	Any

Copy

Copies the store contents and terminates the function.

Service — *See Fig. 3-78.* **This menu provides various service functions.**

Set-up — Leads to the Set-up Menu, which enables the user to set the instrument's clock, define passwords, configure memory cards and install software options.
See page 3-285.

Status — Leads to the Status Menu, which allows the user to examine the power on test results and the build state of the instrument.
See page 3-290.

Instrument Calibrations — Leads to the Instrument Cals Menu, which provides calibration facilities for the instrument.
See page 3-293.

Tests — Leads to the Tests Menu, which enables the display and keyboard to be checked for correct operation.
See page 3-299.

Det / Sensor Specs — Leads to the Edit Specs Menu, which is used to modify detector correction specifications or sensor calibration data tables.
See page 3-300.

Diagnostics — Leads to the Diagnostics Menu.
See page 3-301.

Return to Utility — Returns control to the Utility Menu.

Set-up

See Fig. 3-79. **This menu provides facilities for setting the instrument's real-time clock, setting user-defined passwords, configuring memory cards and installing software options.**

Set Date & Time

Leads to the Date & Time Menu, which is used for setting the instrument's real time clock.
See page 3-286.

Reset Op Hours Clock

This is a Marconi Password protected function and is not available to the user.

Set Passwords

Leads to the Set Passwords Menu, which is used to set the two user-defined passwords. This facility is Primary Password protected.
See page 3-287.

Configure Memory Card

Leads to the Config Card Menu, which is used to configure memory cards before use. This function is Level 1 Password protected.
See page 3-288.

Install S/W Option

Leads to the Install S/W Opt Menu, which is used to install software options from a memory card.
See page 3-290.

Set Serial Number

This is a Marconi Password protected function and is not available to the user.

Set MTS Options

Leads to the Set MTS Options function. This function allows the instrument's hardware options to be configured. This facility is Primary Password protected.

Return to Service

Returns control to the Service Menu.

Date & Time

See Fig. 3-79. **This menu is used to set the instrument's real-time clock and calendar.**

A form is displayed on the screen (Fig. 3-73) showing the current time and date, together with soft keys for parameter selection. Pressing a soft key enables the corresponding value to be changed, as follows:

Rotary Control √	Step Keys √	Numeric Pad √	Terminator Any

The displayed time and date will be regularly updated to reflect any changes that are made.

Set Hours — Enables the Hours to be set.

Set Minutes — Enables the Minutes to be set.

Set Seconds — Enables the Seconds to be set.

Set Day — Enables the Day to be set.

Set Month — Enables the Month to be set.

Set Year — Enables the Year to be set.

Return to Set-up — Returns control to the Set-up Menu.

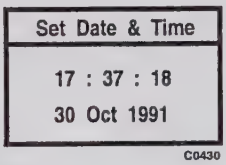


Fig. 3-73 Setting Date and Time

Set Passwords

See Fig. 3-79. **A form is displayed on the screen containing the Level 1 and Level 2 user-defined passwords. The soft keys are used to select the password to be changed.**

The Set Password function requires entry of the instrument's Primary Password before the user-defined passwords can be changed (see page 3-13).

Set Level 1 Password

Enables the Level 1 Password to be set by entering a 4-digit number in the range 1000 to 9999.

Rotary Control	×	Step Keys	×	Numeric Pad	√	Terminator	Any

Set Level 2 Password

Enables the Level 2 Password to be set by entering by entering a 6-digit number in the range 100000 to 999999.

Rotary Control	×	Step Keys	×	Numeric Pad	√	Terminator	Any

Return to Set-up

Returns control to the Set-up Menu.

Config Card

See Fig. 3-79. **This menu is used to initialise a blank memory card and configure it to hold a number of stores. These stores are extensions of the instrument's resident stores, and can be used in the same way as the resident ones. The following store types can be located on the card:**

User Source Power Calibration
Power Sensor Calibration Data
Reflection Analyzer Calibration Data
Trace Memory
Instrument Settings

Since any data present on the memory card will be destroyed by the configuration process, this function is Level 1 Password protected.

A form is displayed showing identity of the card, the store types and their sizes (in bytes), and the number of stores allocated for each type. The current amount of memory remaining on the card is also shown (see Fig. 3-74).

Soft keys are displayed for each of the above store types. Pressing a soft key enables the user to change the number of stores allocated for the selected store type. If the number of stores entered would cause the memory capacity of the card to be exceeded, the number of stores will be limited to the maximum number possible.

The memory card can also be used to store macros (see [MACRO] key description). Any space not allocated for the above fixed length stores can be used for macros.

Source Power Cal

Enables a specified number of stores to be allocated for user source power calibration.

Rotary Control √	Step Keys √	Numeric Pad √	Terminator Any

Sensor Cal Data

Enables a specified number of stores to be allocated for power sensor calibration data.

Rotary Control √	Step Keys √	Numeric Pad √	Terminator Any

Trace Memory

Enables a specified number of stores to be allocated for trace memories.

Rotary Control √	Step Keys √	Numeric Pad √	Terminator Any

Instrument Settings

Enables a specified number of stores to be allocated for instrument settings.

Rotary Control √	Step Keys √	Numeric Pad √	Terminator Any

Adapter Stores

Leads to the Adapt Stores Menu.
This soft key will oly be displayed if the 6210 Reflection Analyzer is connected.
See page 3-289.

Edit Title

Leads to a sub-menu and displays a form which enables a text string of up to twenty characters to be entered as the identity of the card. The method of entry is the same as that described for the Screen Title Menu (page 3-276).

Configure Card

Initiates the configuration process.

Return to Set-up

Terminates the configure memory card function. The function prompts for confirmation if the store allocation for any of the store types has been changed.

Configure Memory Card		
Title : PRODUCTION TEST 1-9		
Store Type	Size	Number
Source Power Calibration	2512	1
Sensor Calibration Data	520	2
Trace Memory	7092	2
Instrument Settings	6380	5
Reflection Analyzer Calibration	38760	1
Reflection Analyzer Cal Kit	284	20
Macro Memory: 36896		

Fig. 3-74 Configuring a Memory Card

UTILITY | Service | Set-up | Configure Memory Card | Adapter Stores

Adapt Stores

See Fig 3-79. **This menu is used to specify the number of reflection analyzer stores.**

Reflection Analyzer Cal

Enables a specified number of stores to be allocated for refection anlayzer calibration data.

Rotary Control √ Step Keys √ Numeric Pad √ Terminator Any

Refl Analyzer Cal Kit

Enables a specified number of stores to be allocated for reflection analyzer calibration kits.

Rotary Control √ Step Keys √ Numeric Pad √ Terminator Any

Return to Config Card

Returns control to the Config Card Menu.

UTILITY | Service | Set-up | Install S/W Option

Install S/W Opt *See Fig. 3-79.* **This menu is used to install a software option from a memory card.**

The cards are supplied configured so that the software option can only be used in one instrument. When the card is inserted into the front panel slot and this soft key is pressed, the card will first be checked to determine if it has been used in an instrument before. If not, a special code will be written to the card. Thereafter, the card will only enable software options in that one specific instrument.

If the card has been used previously, software options will only be enabled if the instrument is the same as before. If this is not the case, no options will be enabled, nothing will be written to the card, and a message will displayed informing the user.

To install a software option, the card is inserted and the sequence of key presses shown above is performed. If the card is not a software option card, the user will be informed by a displayed message that an invalid card has been inserted. A valid card results in a window being displayed informing the user that the software identified on the card is about to be installed and to press *[Continue]* when ready. When installation is complete, the user is informed and is returned to the Set-up menu.

Continue Initiates installation of the software option from a memory card that has previously been inserted into the memory card slot.

Abort Terminates the function without installing the software option.

UTILITY | Service | Status

Status *See Fig. 3-78.* **This menu allows the user to examine the power on test results and the build state of the instrument.**

Display Test Results Leads to the Test Results Menu, which enables power on test results to be displayed and printed.
See below.

Erase Test Results Clears the power on test results, i.e. sets all the tests to 'pass'. This function is confirmation protected.

Display Build State Displays the build state of the instrument, including the total number of hours that the instrument has been operating, and the time and data of the most recent frequency standard cal and power reference cal. The *[Print]* soft key sends this data to the printer. The instrument's build state can also be printed out by pressing the [COPY] key on power up.

Return to Service Returns control to the Service Menu.

Test Results

See Fig. 3-78. **This menu is used to display and print the results of the tests carried out by the instrument at power on.**

The test results occupy several pages which can be accessed using the *[Page Up]* and *[Page Down]* soft keys. The overall pass/fail indication is shown at the top of the first page. The MTS maintains records in non-volatile memory of the time and date of the most recent failure for each test. The menu also gives information about failures during source calibration.

The following self-tests are carried out at power-on.

Bootstrap Loader Tests. These are carried out by the program that loads programs into the Digital Board RAM and the Analogue Board RAM (for the Graphics System) for execution by the associated transputers. The bootstrap loader also loads code into two additional processors in the reflection ananlyzer, if it is present.

ROM Test. At power on, the bootstrap loader generates and stores a ROM checksum, and this is compared with the stored checksum generated at the previous power on. If the checksums differ, a failure message is displayed together with the previous and current checksums.

Digital Board Transputer. If this device is unserviceable it is very unlikely that any software will run, therefore no attempt is made to test or report failures.

Analogue Board Transputer Test (Graphics System). The internal memory in the Graphics System transputer chip is tested via the link from the Digital Board transputer. If a failure is detected, the message *Analogue board processor failure* is sent to the printer port. Without the graphics transputer, no further testing is possible.

Reflection Analyzer Transputer Tests. If the reflection analyzer is present, its two processors are tested via a link from the Digital Board transputer. If either processor fails the test, the message *Adaper processor failure* is sent to the printer port. The instrument will then power up as an MTS with no reflection analyzer fitted, and all reflection analyzer functions will be disabled.

Memory Tests. These are carried out on both the Digital Board transputer (T1) and the Analogue Board transputer (T2). The first occurrence of a failure is logged and the message *Digital board memory failure* or *Analogue board memory failure* is output to the printer port. The transputer number (T1 or T2), address and test pattern are recorded in the Test Results.

Memory tests are also carried out on the two processors within the reflection analyzer, if it is present. If either of these have failed, the message *Adapter processor memory failure* is printed. The transputer number (T3 or T4), address and test pattern are recorded in the Test Results as they are for T1 and T2. In the event of a reflection analyzer memory failure, the instrument will power up as an MTS with no reflection analyzer fitted, and all reflection analyzer functions will be disabled.

Device Tests. Tests are carried out on the GPIB chip, the keyboard and the real-time clock. Failures are reported in the Test Results, and the following messages are sent to the printer port:

Keyboard failure
GPIB chip failure
Real time clock failure

If the clock fails, an attempt is made to set it to the default date and time: Midnight, 1st January, 1990.

Subsystem Tests. These tests are carried out as the main software components of the system initialise the hardware for which they are responsible.

Graphics. Reports "pass" if the graphics system appears to have initialised satisfactorily.

Source. Reports "pass" if the source system has initialised satisfactorily and locking is achieved.

Data Acquisition. Tests are carried out on the following data acquisition components and the pass/fail status is reported:

ADC
Calibration DAC
Main amplifier
Sequencer

Non-Volatile Memory. Each store within the instrument's non-volatile memory is protected by a checksum. When data is accessed from a store, the checksum is re-calculated. If the data within a store is found to be corrupt, a "Store Corrupted" error message is displayed, and an entry made in the Test Results. Corrupted stores are automatically reset to empty, or overwritten with default data from ROM, depending on the store type.

Power Supply Temperature Monitoring. The power supply temperature is checked every few minutes. If operational limits are exceeded, a "Power supply overheating" message is displayed, and an entry made in the Test Results. (If the temperature continues to rise, the power supply will eventually shut down automatically.)

Source Calibration. If a source frequency cal or power cal fails, detailed information concerning the failure is recorded. This is described fully in the 6200 Maintenance Manual.

Page Up — Displays the previous page of test results.

Page Down — Displays the next page of test results.

Print — Enables a hard copy printout of the test results to be obtained.

Return to Status — Returns control to the Status Menu.

Instrument Cals

See Fig. 3-80. **This menu provides facilities calibrating the internal frequency standard and power reference, and calibrating the instrument to match non-standard test conditions (e.g. high ambient temperature), or calibration at the output of an amplifier, filter, cable or autotester.**

The calibration process is controlled automatically by the MTS. For operations taking more than a few seconds to complete in the following sub-menus, a percentage complete indicator will be displayed after the function has been initiated.

Frequency Standard Cal

Leads to the Freq Std Cal Menu, which is used to calibrate the instrument's internal frequency standard. This facility is Level 2 Password protected.
See page 3-294.

Power Ref Cal

Leads to the Pwr Ref Cal Menu, which is used to calibrate the power reference output.
See page 3-294.

Perform Freq Cal

Calibrates the YIG oscillators of the instrument's source using the internal counter. When this soft key is pressed, frequency calibration commences. When calibration is complete, the user is informed and is returned to the Instrument Cals Menu.
This soft key is not displayed on the 6202, since it does not contain any YIG oscillators.

Source Power Cal

Leads to the Src Power Cal Menu, which provides power calibration facilities for the instrument's source.
See page 3-295.

Transfer to Primary

Leads to the Transfer to Pri Menu, which is used to transfer a user power calibration into the Primary calibration store. This function is Level 2 Password protected.
See page 3-298.

Select Power Cal

Leads to the Select Pwr Cal menu, which is used to select which power calibration is to be used in the instrument.
See page 3-298.

Adapter Cals

Leads to the Adapter Cals Menu, which provides calibration functions for the Reflection Analyzer detector diodes.
(See page 3-295)
This soft key is only displayed if the 6210 Reflection Analyzer is connected.

Return to Service

Returns control to the Service Menu.

UTILITY | Service | Instrument Calibrations | Frequency Standard Cal

Freq Std Cal

See Fig. 3-80. **This menu is used to calibrate the instrument's internal frequency standard against an external frequency standard. This facility is Level 2 Password protected**

A form is displayed containing the date and time of the last frequency calibration. A message is displayed prompting the user to connect the frequency standard to the FREQ STD INPUT/OUTPUT connector on the rear panel, and to press the *[Continue]* soft key when ready. When calibration is complete, the user is informed and is returned to the Instrument Cals Menu.

Continue Initiates calibration of the internal frequency standard.

Abort Calibration Terminates the function without performing a frequency calibration.

UTILITY | Service | Instrument Calibrations | Power Ref Cal

Pwr Ref Cal

See Fig. 3-80. **This menu is used to calibrate the power reference output of the instrument. This facility is Level 2 Password protected.**

A message is displayed prompting the user to disconnect the sensor from any RF source and to press the *[Continue]* soft key when ready. When the sensor has been zeroed, the user is prompted to connect the sensor to an external power reference standard and press *[Continue]* when ready. Readings are then taken from the standard. When this has been done, the user is asked to connect the sensor to the instrument's POWER REF connector and press *[Continue]* when ready. The instrument's power reference is then calibrated. When complete, the user is informed and is returned to the Instrument Cals Menu.

Continue Initiates sensor zeroing and calibration of the power reference.

Abort Calibration Terminates calibration.

UTILITY | Service | Instrument Calibrations | Source Power Cal

Src Power Cal

See Fig. 3-80. **This menu provides broadband and narrowband power calibration facilities for the instrument's source.**

In broadband calibration, the MTS is calibrated for frequency and power over its full operating range. The narrowband calibration facility enables a power calibration to be performed over a limited frequency range. This makes it possible to calibrate the instrument at the output of frequency selective devices such as filters and amplifiers. The calibration data can be stored in the instruments non-volatile memory or on a memory card, while still retaining the primary calibration, created during factory calibration.

Broadband Power Cal

Leads to the Power Cal Menu (Broadband), which is used to carry out a full frequency range power calibration of the instrument's source. This facility is Level 1 Password protected.
See page 3-296.

Narrowband Power Cal

Leads to the Power Cal Menu (Narrowband), which is used to carry out a narrowband frequency range power calibration of the instrument's source. This facility is Level 1 Password protected.
See page 3-297.

Return to Inst Cals

Returns control to the Instrument Cals Menu.

UTILITY | Service | Instrument Calibrations | Adapter Cals

Adapter Cals

See Fig. 3-80. **This menu is used to carry out a calibration of the detector diodes in the 6210 and generate new linearity polynomials for them. If required, the 6210 detector diode polynomials can be reset to their default (factory set) values.**

Refl Analyzer Lin Cal

This soft key initiates calibration of the 6210 detector diodes and generates new linearity polynomials for them. A message is displayed prompting the user to connect the MTS RF output to the 6210 RF input, and to ensure that nothing is connected to the 6210 test port. A sub-menu is also displayed containing *[Continue]* and *[Abort Calibration]* soft keys.

On pressing *[Continue]*, this instrument will make its initial set of measurements and a percentage complete indicator will be displayed. When the data has been acquired, the user is prompted to connect the MTS RF output to the 6210 test port, and to connect a matched load to the 6210 RF input. After pressing *[Continue]*, a percentage complete indicator will again be displayed while a second set of measurements are made. When completed, the new linearity polynomials are generated, the calibration will exit, and the user is informed that the new polynomials are in use.

Default Lin Cal Data

Resets the 6210 detector diode polynomials to their default (factory set) values.

Return to Inst Cals

Returns control to the Instrument Cals Menu.

Power Cal

Fig. 3-80. **This menu is used to carry out a full frequency range power calibration of the instrument's source. This facility is Level 1 Password protected.**

A window is displayed prompting the user to connect the sensor to input D and to the RF OUTPUT connector, and to press the *[Continue]* soft key when ready. After pressing *[Continue]*, percentage complete indicators are displayed while linearity and flatness data are being collected.

When the data has been acquired, the user can save the calibration by specifying a store then pressing the *[Save]* soft key. The MTS provides two internal stores for this; a suitably configured memory card can be used for additional storage. Before saving, the user is asked if he wishes to change the identity of the calibration, using the same method as in the Screen Title Menu (see page 3-276).

Note...

Instead of calibrating at the RF output connector, calibration may be carried out at the output of any cables, adapters, etc. that are connected to the RF output.

Continue — Initiates broadband source power calibration.

Set Start Frequency — *This soft key is unselectable.*

Set Stop Frequency — *This soft key is unselectable.*

Select Cal Fact Table — Used to select the cal factor table that the cal factor for input D will be selected from, by entering the identity number of the table from the keyboard.

Edit Sensor Cal Data — Leads to the Edit Spec Menu, which is used for editing the calibration data for the current sensor. This menu is the same as for the measurement setup for a scalar channel.
See page 3-70.

Sensor Cal — Leads to the Sensor Cal Menu, which is used to zero the power sensor and to calibrate it against the reference.
See page 3-88

Abort Calibration — Terminates calibration.

Power Cal

See Fig. 3-80. **This menu is used to carry out a narrowband frequency range power calibration of the instrument's source. This facility is Level 1 Password protected.**

A window is displayed showing the frequency range the calibration will cover (initially the entire range of the source), and a message is displayed prompting the user to connect the sensor to input D and to the RF OUTPUT connector. The frequency range that the calibration will cover is specified using the *[Set Start frequency]* and *[Set Stop Frequency]* soft keys. After pressing *[Continue]*, percentage complete indicators are displayed while linearity and flatness data are being collected.

When the data has been acquired, the user can save the calibration by specifying a store then pressing the *[Save]* soft key. The MTS provides two internal stores for this; a suitably configured memory card can be used for additional storage. Before saving, the user is asked if he wishes to change the identity of the calibration, using the same method as in the Screen Title Menu (see page 3-276)

Note...

Instead of calibrating at the RF output connector, calibration may be carried out at the output of any cables, adapters, etc. that are connected to the RF output.

Continue

Initially checks that the start and stop values are within the frequency range of the source, and then initiates the narrowband calibration.

Set Start Frequency

Enables the start frequency of the calibration to be specified.

Rotary Control √	Step Keys √	Numeric Pad √	Terminator 10+

Set Stop Frequency

Enables the stop frequency of the calibration to be specified.

Rotary Control √	Step Keys √	Numeric Pad √	Terminator 10+

Select Cal Fact Table

Used to select the cal factor table that the cal factor for input D will be selected from, by entering the identity number of the table from the keyboard.

Edit Sensor Cal Data

Leads to the Edit Spec Menu, which is used for editing the calibration data for the current sensor. This menu is the same as for the measurement setup for a scalar channel.
See page 3-70.

Sensor Cal

Leads to the Sensor Cal Menu, which is used to zero the power sensor and to calibrate it against the reference.
See page 3-88

Abort Calibration

Terminates calibration.

UTILITY | Service | Instrument Calibrations | Transfer to Primary

Transfer to Pri

See Fig. 3-80. **This menu is used to replace the current primary power calibration with a user power calibration created using the Src Power Cal Menu.**

This function overwrites the primary calibration, which is stored in EEPROM, and is Level 2 Password protected. The primary calibration store of a new instrument contains the factory generated power calibration data. Only broadband power calibration data can be transferred to the primary store. A window is displayed containing a summary of the current primary calibration and a summary of user calibration store 1.

Transfer

Overwrites the Primary calibration store with the user calibration data contained in a selected store.
This soft key is unselectable if the displayed store is narrowband.

Select Store

Used to select a user store by entering the store identity number from the keyboard.

Rotary Control ×	Step Keys ×	Numeric Pad √	Terminator Any

Previous Store

Selects the previous user calibration store.

Next Store

Selects the next user calibration store.

Return to Inst Cals

Returns control to the Instrument Cals Menu.

UTILITY | Service | Instrument Calibrations | Select Power Cal

Select Pwr Cal

See Fig. 3-80. **This menu allows the user to select which power calibration is to be used in the instrument. A window is displayed containing a summary of the current calibration and indicates whether it is a primary or user calibration.**

Primary Calibration

Selects primary calibration

User Calibration

Allows a user calibration to be selected by entering the identity number of the required store.

Rotary Control ×	Step Keys ×	Numeric Pad √	Terminator Any

Return to Inst Cals

Returns control to the Instrument Cals Menu.

Tests

See Fig. 3-78. **This menu enables the operator to verify that the display and keyboard are functioning correctly.**

Test Keyboard

Allows each key on the front panel to be tested individually, and allows the rotary control to be tested for clockwise and anti-clockwise rotation.

A form is displayed on the screen containing a representation of the front panel key layout. For each keypress or rotary control movement detected, the corresponding symbol on the front panel representation will be highlighted, and remains highlighted for the duration of the test. The *[Exit]* soft key terminates the test.

Test Display

This function is Marconi password protected and is not available to the user.

Return to Service

Returns control to the Service Menu.

Edit Specs

See Fig. 3-78. **This menu is used to edit the sensitivity and power factor values of the detector correction specifications for Marconi and user-defined detectors, and to edit the power sensor calibration data tables.**

Edit Det Corr Spec

Leads to the Edit Det Specs Menu, which enables editing of correction data for the user-defined detectors.
See page 3-69.

Edit MI Det Corr Spec

This is a Marconi Password protected function and is not available to the user.

Edit Sensor Cal Data

Leads to the Edit Spec Menu, which is used for editing the calibration data for the current sensor. This menu is the same as for the measurement setup for a scalar channel.
See page 3-70.

Return to Service

Returns control to the Service Menu.

UTILITY **Service** **Diagnostics**

Diagnostics

See Fig. 3-81. **The Diagnostics Menu provides diagnostics functions for the instrument's source, data acquisition system and frequency counter.**

Source Diagnostics
Leads to the Src Diag Menu.
See below.

Data Acq Diagnostics
Leads to the DAcq Diag Menu.
See page 3-307.

Counter Diagnostics
Leads to the Counter Diag Menu.
See page 3-310.

Save Cal Variance
Used to store the variance data of the reflection analyzer calibration currently being used by the instrument into a trace memory. The variance can then be viewed by displaying the memory. To save the data to a specific memory location, the memory identity number is entered in the input field.
This soft key will only be displayed if the 6210 Reflection Analyzer is connected.

Return to Service
Returns control to the Service Menu.

UTILITY **Service** **Diagnostics** **Source Diagnostics**

Src Diag

See Fig. 3-81. **This menu is used to perform diagnostics functions on the instrument's source, by permitting low level monitoring and control of various source parameters.**

Band Select Word
Leads to the Band Select Menu.
See page 3-302.

RF Path Switch
Leads to the RF Path Menu.
See page 3-303.

Source Control
Leads to the Src Control Menu.
See page 3-304.

Counter Functions
Leads to the Ctr Funcs Menu.
See page 3-305.

Counter
Selects the 'Counter' setting of the SP2T switch on the microwave chassis; the switch then routes the COUNTER input signal to the sampling gate.

YIG Lock
Selects the 'YIG lock' setting of the SP2T switch on the microwave chassis; the switch then routes the YIG signal to the sampling gate.

More
Leads to the Src Diag More Menu.
See page 3-305.

Exit Src Diagnostics
Returns control to the Diagnostics Menu, after prompting for confirmation.

Band Select

See Fig. 3-81. **This menu enables individual bits of the band select word to be set on or off.**

The band select word comprises 14 digital lines which are used to control the MTS source. The meaning of each bit is shown on the form that is displayed (Fig. 3-75). An individual bit is selected using the *[⇑]* and *[⇓]* soft keys, and is toggled on or off using the *[On / Off]* soft key. (On instruments other than 6204 the 26.5 - 40 GHz bit is replaced with the word 'Reserved'.)

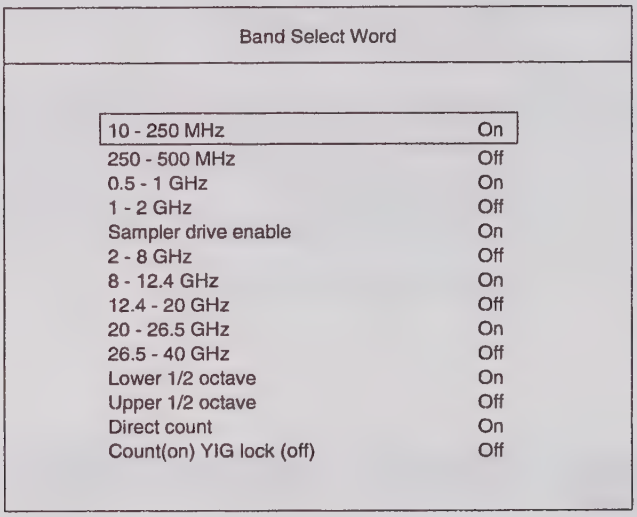

Band Select Word
10 - 250 MHz On
250 - 500 MHz Off
0.5 - 1 GHz On
1 - 2 GHz Off
Sampler drive enable On
2 - 8 GHz Off
8 - 12.4 GHz On
12.4 - 20 GHz Off
20 - 26.5 GHz On
26.5 - 40 GHz Off
Lower 1/2 octave On
Upper 1/2 octave Off
Direct count On
Count(on) YIG lock (off) Off

Fig. 3-75 Band Select Word Form

On / Off — Used to toggle the selected bit on or off.

⇑ — Selects the previous bit of the band select word.

⇓ — Selects the next bit of the band select word.

Return to Src Diag — Returns control to the Src Diag Menu.

RF Path

See Fig. 3-81. **This menu is used to control the setting of the SP4T (or SP5T) PIN switch on the microwave chassis and, for 6204 instruments, to switch the frequency doubler circuit in or out.**

Synth Band — Sets the PIN switch to the 'Synth Band' position.

2-8 GHz — Sets the PIN switch to the '2 - 8 GHz' position.
This soft key is not selectable on 6202 instruments.

8-12 GHz — Sets the PIN switch to the '8 - 12 GHz' position.
This soft key is not selectable on 6201 and 6202 instruments.

12-20 GHz — Sets the PIN switch to the '12 - 20 GHz' position.
This soft key is not selectable on 6201 and 6202 instruments.

20-26.5 GHz — Sets the PIN switch to the '20 - 26.5 GHz' position.
This soft key is not selectable on 6200, 6201 and 6202 instruments.

Off — Sets the PIN switch to the 'Off' position.

Doubler — Toggles the frequency doubler on or off.
This soft key is only displayed on 6204 instruments.

Return to Src Diag — Returns control to the Src Diag Menu.

Src Control

See Fig. 3-81. **This menu provides the following functions for controlling the source.**

Changing the values of the level DAC, YIG tuning DAC and YIG FM gain.

Selection of the synthesizer loop bandwidth, which is the frequency of the synthesizer phase-locked loop. Low bandwidth reduces the spurious signal content of the RF output but slows down the response; high bandwidth has the opposite effect.

Enabling/disabling of the CW filter. The CW filter is used to reduce the YIG oscillator tuning bandwidth and lower the residual FM to the values specified in the Performance Data section of Chapter 1. However, this also slows down the response due to the longer settling time.

Level DAC

Enables the value of the Level DAC to be changed.

Rotary Control √	Step Keys √	Numeric Pad √	Terminator Any

YIG Tuning DAC

Enables the value of the YIG tuning DAC to be changed.

Rotary Control √	Step Keys √	Numeric Pad √	Terminator Any

IG FM Gain

Enables the value of the YIG FM gain to be changed.

Rotary Control √	Step Keys √	Numeric Pad √	Terminator Any

FM Zero

Temporarily sets the YIG FM gain to zero in order to centralise the currently selected YIG oscillator.

Synth Loop BW High

The loop bandwidth is always HIGH irrespective of the operating mode.

Synth Loop BW Low

The loop bandwidth is always LOW irrespective of the operating mode.

CW Filter

Toggles the CW filter on or off irrespective of the operating mode.

Return to Src Diag

Returns control to the Src Diag Menu.

UTILITY | Service | Diagnostics | Source Diagnostics | Counter Functions

Ctr Funcs — *See Fig. 3-81.* This menu is used to perform diagnostic functions on the instrument's counter.

Set UHF Freq — Used to set the counter UHF frequency within the range 1 - 2 GHz.

Rotary Control √	Step Keys √	Numeric Pad √	Terminator 10+

Set Gate Time — Enables the counter gate time to be changed.

Rotary Control √	Step Keys √	Numeric Pad √	Terminator 10–

Measure — Initiates a measurement of the counter IF for the specified gate time.

Direct Count — Sets the counter mode to 'direct count'.

Harmonic Count — Sets the counter mode to 'harmonic count'

Return to Src Diag — Returns control to the Src Diag Menu.

UTILITY | Service | Diagnostics | Source Diagnostics | More

Src Diag More — *See Fig. 3-81.* **This menu is used to toggle individual pads of the step attenuator on or off, if this option is fitted, and to change the values of the standard tuning DACs.**

Pad 1 (20 DB) — Used to toggle Pad 1 of the step attenuator on or off.

Pad 2 (10 DB) — Used to toggle Pad 2 of the step attenuator on or off.

Pad 3 (20 DB) — Used to toggle Pad 3 of the step attenuator on or off.

Pad 4 (20 DB) — Used to toggle Pad 4 of the step attenuator on or off.

Std Tuning (Coarse) — Enables the value of the standard tuning DAC (coarse) to be changed.

Rotary Control √	Step Keys √	Numeric Pad √	Terminator Any

Std Tuning (Fine) — Enables the value of the standard tuning DAC (fine) to be changed.

Rotary Control √	Step Keys √	Numeric Pad √	Terminator Any

Halt On Error	Used to select whether the source power cal will halt the calibration if it fails.
Return to Src Diag	Returns control to the Src Diag Menu.

DAcq Diag

See Fig. 3-81. **This menu is used to perform diagnostics functions on the instrument's data acquisition system, by permitting low level monitoring and control of various data acquisition system parameters.**

A form will be displayed containing the current values of the selected ADC input, the range (if input is 1 to 4), offset DAC value and Cal DAC value. The form is only displayed if the service mode is turned on (see below).

Service Mode

This soft key toggles the data acquisition service mode on or off. Putting the data acquisition system into the service mode has the following effects:

The state of critical variables is saved

Automatic range-changing is disabled.

Sequencer control of the ADC multiplexer is disabled.

The message 'DACQ DIAGS MODE ACTIVE' is displayed in place of the screen title showing that Service Mode is enabled.

Set Up Input

Leads to the Set Up Input Menu.
See page 3-308.

Select Range

Enables the input range to be changed.
This soft key will only be selectable if the currently selected input is in the range 1 to 4.

Rotary Control √	Step Keys √	Numeric Pad √	Terminator Any

Gain Correction

Toggles gain correction for the data acquisition system on or off.
This soft key will only be selectable if the currently selected input is in the range 1 to 4.

Data Acq Filter

Toggles the data acquisition filter on or off.
This soft key will only be selectable if the currently selected input is in the range 1 to 4.

Range Changing

Toggles range changing for the data acquisition system on or off.
This soft key will only be selectable if the currently selected input is in the range 1 to 4.

Set DACs

Leads to the Set DACs Menu.
See page 3-310.

Return to Diagnostics

Returns control to the Diagnostics Menu.

Set Up Input

See Fig. 3-81. **This menu is used to define the input that will be used during data acquisition system diagnostics.**

Select ADC Input

Used to select any ADC multiplexer channel, i,e, the input to the ADC. A form is displayed containing the input types together with their identity numbers, and the currently selected input identity in an input field.

Rotary Control ×	Step Keys ×	Numeric Pad √	Terminator	Any

All Detectors

Configures all four inputs A, B, C and D to accept scalar detectors.

ABC Detector D Pwr Sensor

Configures inputs A, B and C to accept scalar detectors and input D to accept a power meter sensor.

Auxiliary Input

Enables the signal present at the front panel AUX INPUT connector to be used by the data acquisition diagnostics.

1st Stage Amp Cal DAC

Enables the signal present at the 1st Stage Amp Cal DAC to be used by the data acquisition diagnostics.
This soft key will only be selectable if the currently selected input is in the range 1 to 4 or 6.

2nd Stage Amp Cal DAC

Enables the signal present at the 2nd Stage Amp Cal DAC to be used by the data acquisition diagnostics.
This soft key will only be selectable if the currently selected input is in the range 1 to 4 or 6.

Reflect DAcq Diagnostics

Leads to the Reflect DAcq Menu.
This soft key will only be displayed if the 6210 Reflection Analyzer is connected, and will only be selectable if the [Auxiliary Input] soft key has been selected.

Return to DAcq Diag

Returns control to the DAcq Diag Menu.

Reflect DAcq

See Fig. 3-81. **This menu provides several diagnostic functions for the reflection analyzer data acquisition system.**

View Reflect ADC Inputs

When this soft key is pressed, a form is displayed containing a list of the reflection analyzer ADC inputs together with their current values, as shown below.

View Reflection Analyzer ADC Inputs	
Ambient Temperature	:1.000 V (28.56C)°C
Integrated Coupler Temperature	:1.000 V (28.56C)°C
Single Coupler Temperature	:1.000 V (28.56C)°C
Internal Air Temperature	:1.000 V (28.56C)°C
Temp Control DAC	:1.000 V
PSU Thermistor	:1.000 V
+5V Ref	:1.000 V
0V Ref	:1.000 V

Set ATG State

In order to calibrate the measurement system for a reflection analyzer measurement, the MTS automatically applies 10 different terminations generated by an arbitrary termination generator (ATG). This soft key can be used to set the ATG state by numeric entry as follows:

Rotary Control	Step Keys	Numeric Pad	Terminator
×	×	√	Any

Temperature Control

Used to toggle the reflection analyzer's temperature control on or off.

Set Temp Control DAC

Enables the reflection analyzer temperature control DAC value to be changed by entering a decimal number.

Rotary Control	Step Keys	Numeric Pad	Terminator
×	×	√	Any

Set Refl Offset DAC

Enables the reflection analyzer offset DAC value to be changed by entering a decimal number.
This soft key will only be selectable if the currently selected input is in the range 1 to 4.

Rotary Control	Step Keys	Numeric Pad	Terminator
√	√	√	Any

High Resolution

Used to toggle the under-range threshold level between its low resolution value (0.5 V) and its high resolution value (0.9 V).

Linearity Correction

Toggles linearity correction for the currently selected ADC Input on and off.
This soft key will only be selectable if the currently selected input is in the range 1 to 4.

Return to Set Up Input

Returns control to the Set Up Input Menu.

UTILITY | Service | Diagnostics | Data Acq Diagnostics | Set DACs

Set DACs

See Fig. 3-81. **This menu is used to change the values of the offset DAC and Cal DAC.**

Set Offset DAC

Enables the 12-bit offset DAC value to be changed, by entering a decimal number.
This soft key will only be selectable if the currently selected input is in the range 1 to 4. It will be unselectable if the [Auxiliary Input] soft key of the Set Up Input Menu has been selected.

Rotary Control √	Step Keys √	Numeric Pad √	Terminator Any

Set Cal DAC

Enables the 16-bit Cal DAC value to be changed, by entering a decimal number.
This soft key will only be selectable if the currently selected input is in the range 1 to 4 and the calibration mode has been selected, or the currently selected input is input 6 (calibration).

Rotary Control √	Step Keys √	Numeric Pad √	Terminator Any

Return to DAcq Diag

Returns control to the DAcq Diag Menu.

UTLITY | Service | Diagnostics | Counter Diagnostics

Counter Diag

See Fig. 3-81. **This menu is used to perform diagnostics functions on the instrument's counter, by allowing the user to set the counter gate time and to trigger a counter measurement.**

Measure

Initiates a counter measurement. The measurement will be displayed in a window together with the intermediate values used to compute it, i.e. IF frequency, LO frequency and harmonic number.

Set Gate Time

Enables the counter gate time to be changed.

Rotary Control √	Step Keys √	Numeric Pad √	Terminator 10–

Return to Diagnostics

Returns control to the Diagnostics Menu.

Applications

See Fig. 3-76. **This menu enables the user to load and run an applications program which is stored on a memory card. The applications software adds new features to the MTS to fulfil a particular requirement (unlike a macro which only controls the existing features of the instrument). When the menu is first entered, a form is displayed showing the applications available on the card, and the current application if one has already been loaded.**

Run Application

When this soft key is pressed, the user is given the choice of running the current application (if any), or running another one by entering the application number from the keyboard.

Auto Run

Toggles the auto run feature on and off. When the instrument powers up, and auto run was previously enabled, any application on the card which has been designated as auto run will be automatically run.

Clear Data Store

Clears applications specific non-volatile settings data stores. This function is confirmation protected..

Return to Utility

Returns control to the Utility Menu.

Fig. 3-76 UTILITY Menus (Sheet 1)

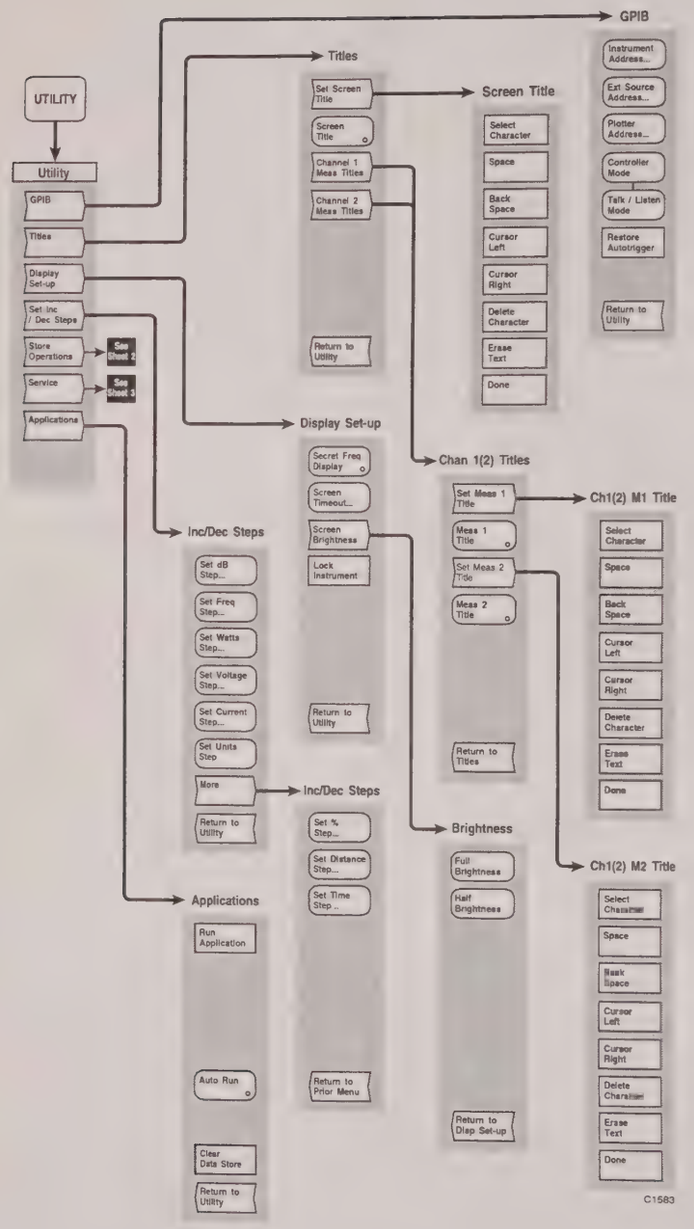
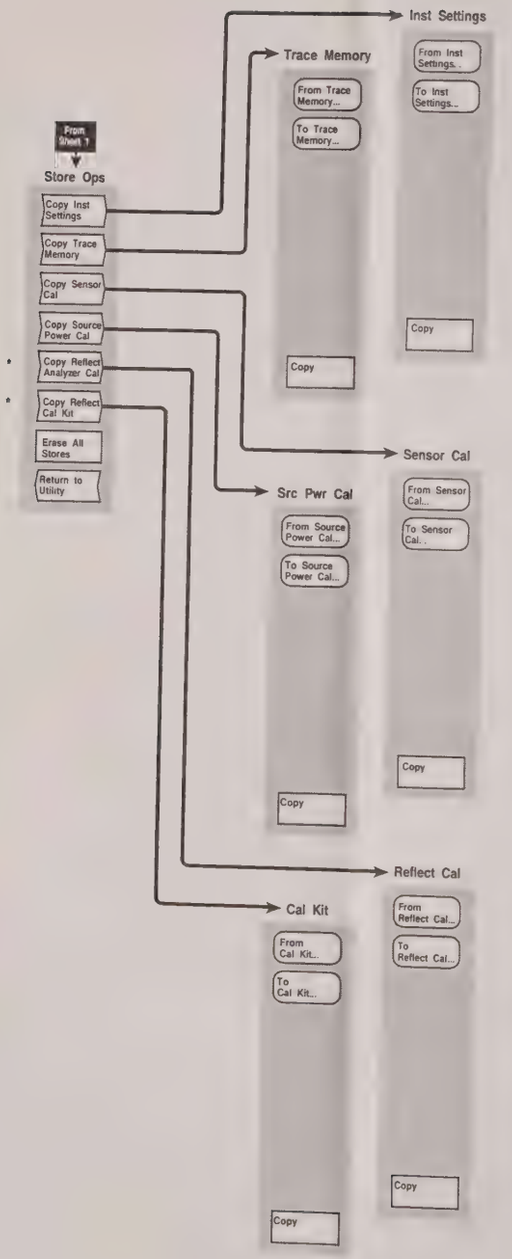


Fig. 3-76 UTILITY Menus (Sheet 1)

Fig. 3-77 UTILITY Menus (Sheet 2)



C1109

* This soft key and the associated menu will only be displayed if the 6210 is connected

Fig. 3-77 UTILITY Menus (Sheet 2)

Fig. 3-78 UTILITY Menus (Sheet 3)

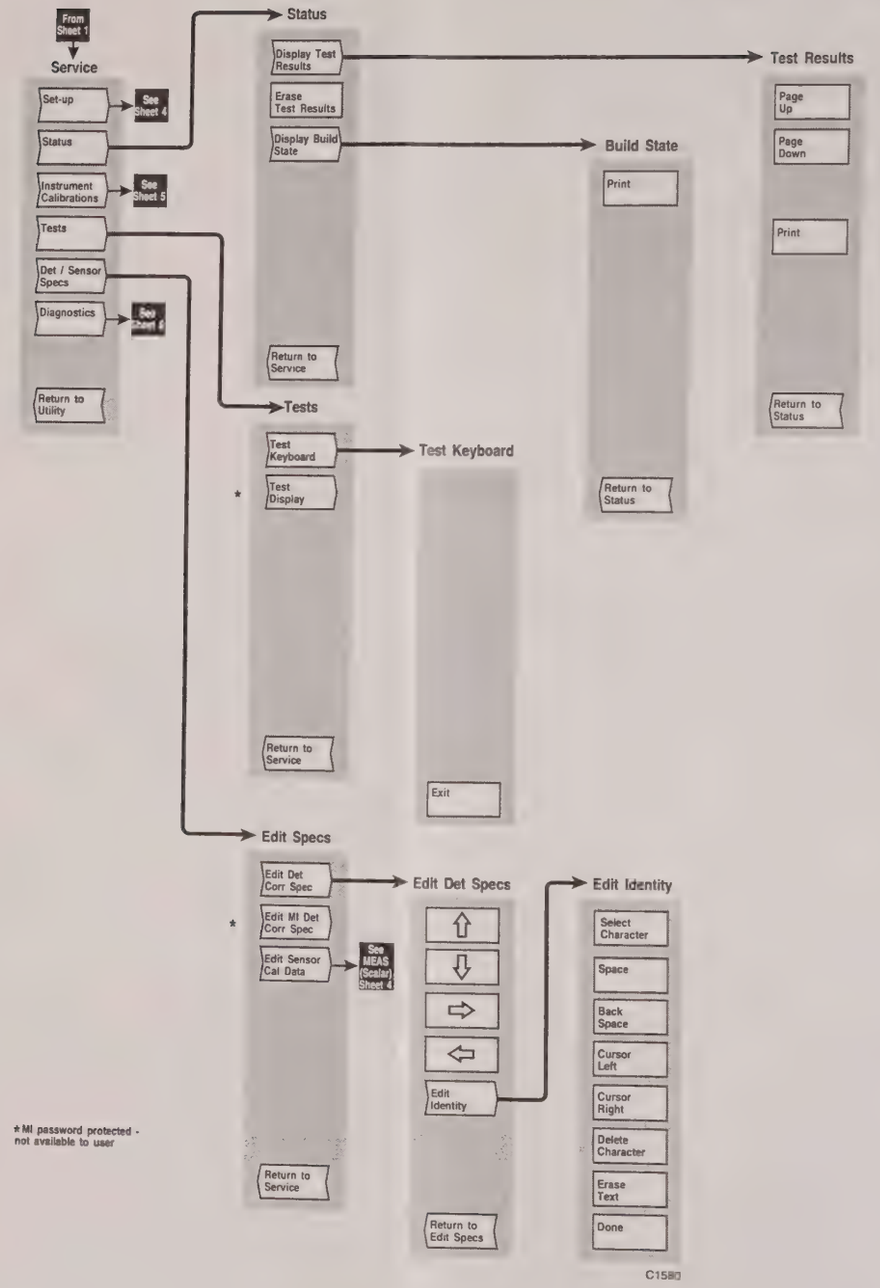


Fig. 3-78 UTILITY Menus (Sheet 3)

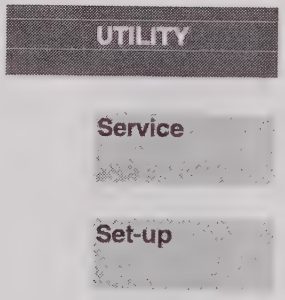


Fig. 3-79 UTILITY Menus (Sheet 4)

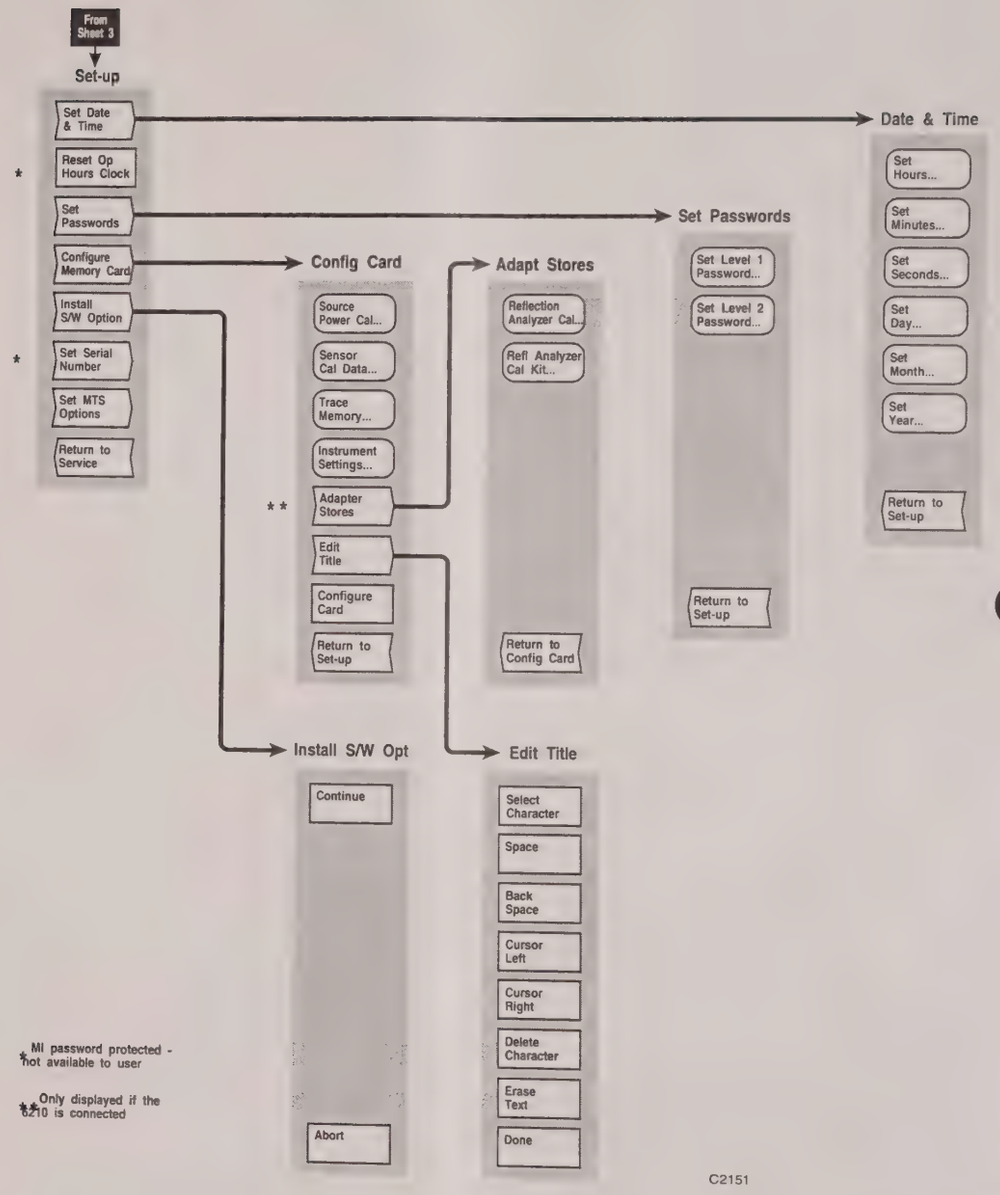


Fig. 3-79 UTILITY Menus (Sheet 4)

Fig. 3-80 UTILITY Menus (Sheet 5)

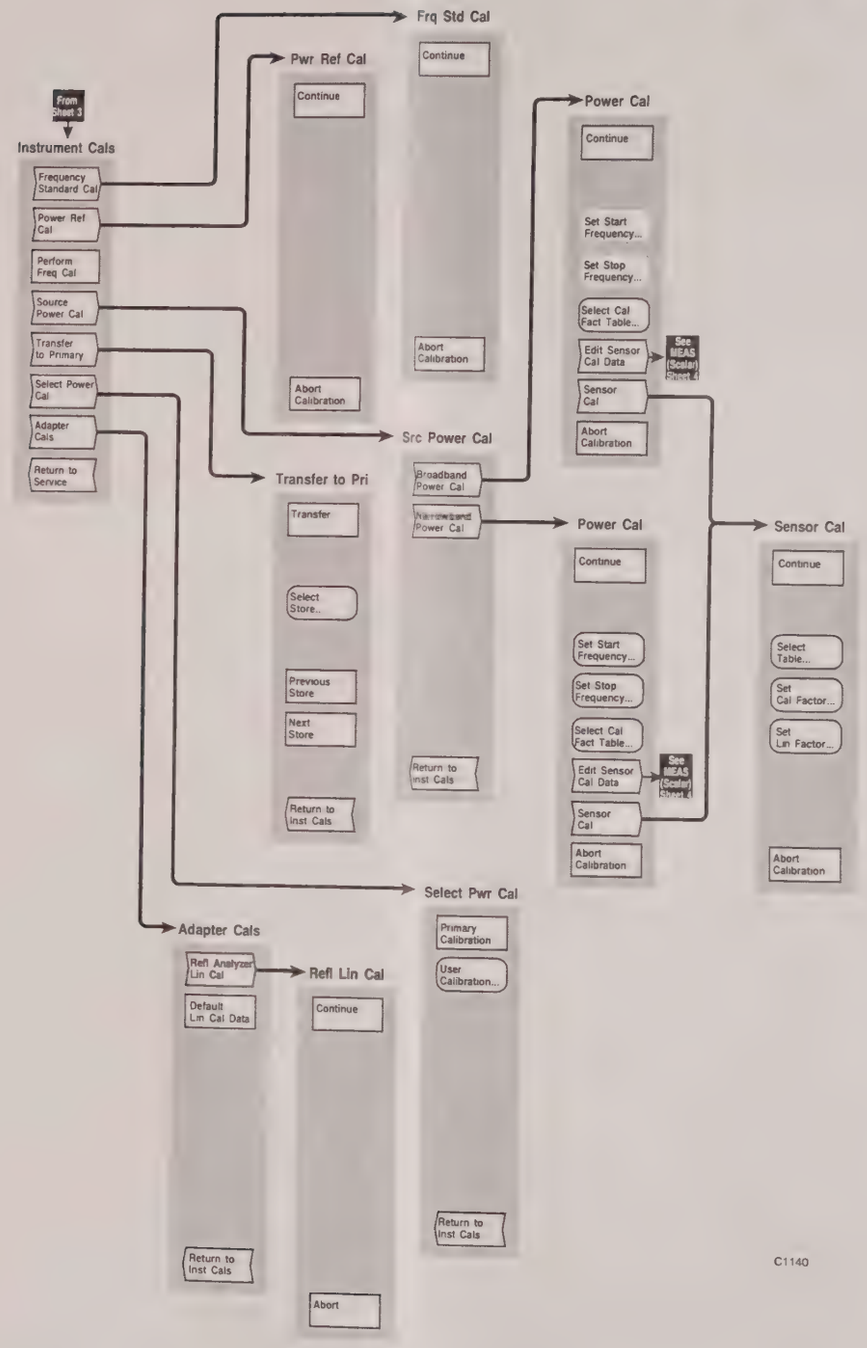


Fig. 3-80 UTILITY Menus (Sheet 5)

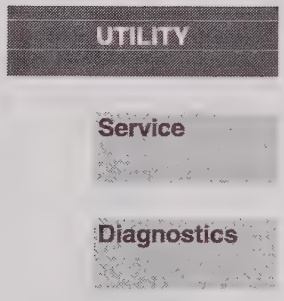


Fig. 3-81 UTILITY Menus (Sheet 6)

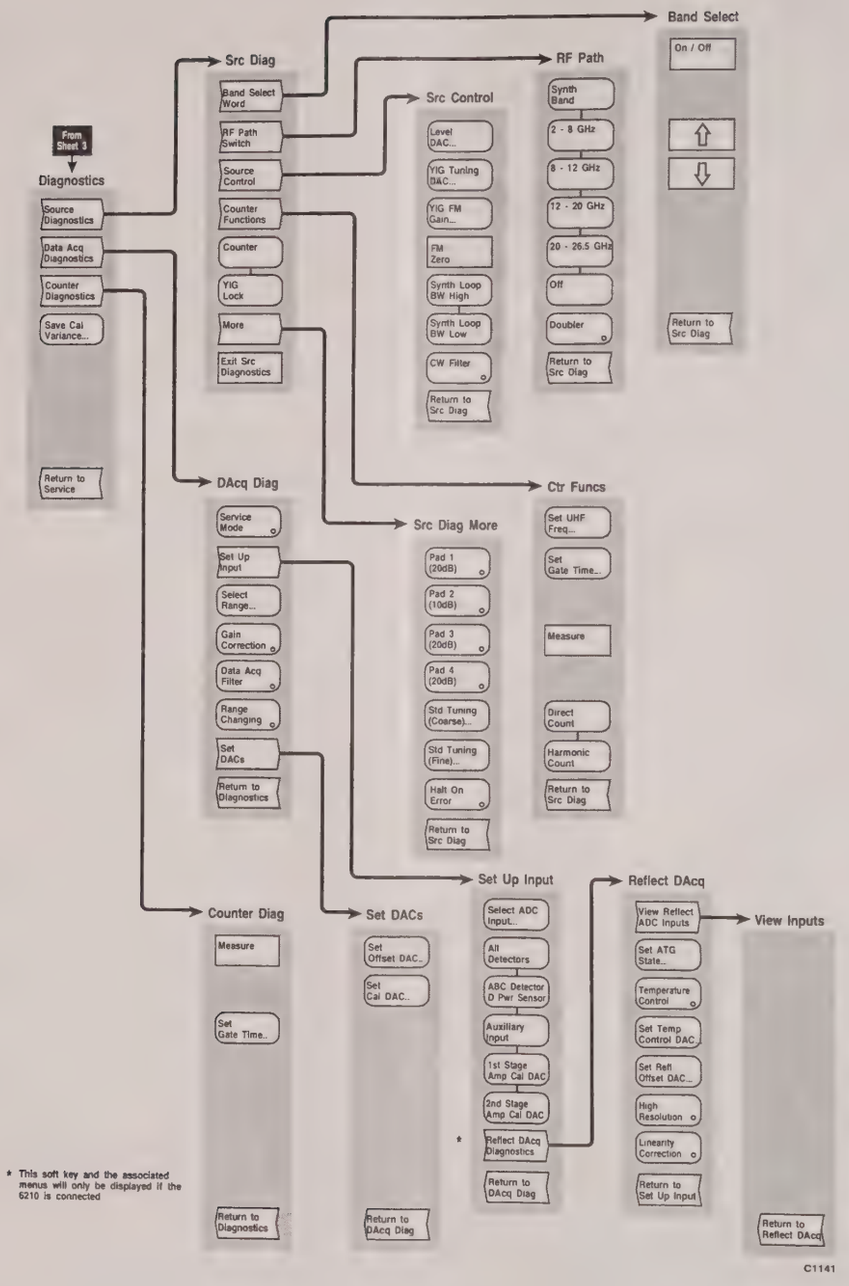


Fig. 3-81 UTILITY Menus (Sheet 6)

[HOLD] KEY

The [HOLD] key does not have an associated menu structure. It is used to hold (freeze) the display of the active measurement. This is useful, for example, if the display is to be photographed. If HOLD is enabled for a swept measurement, changes to trace parameters (such as format, scaling, etc.) will cause the displayed trace to be refreshed from stored data.

Pressing the [HOLD] key again restores normal operation. Hold will also be disabled under the following circumstances:

Swept measurements: channel mode or channel domain changed.
Readout: channel mode or measurement definition changed.

A held measurement is indicated on the display by setting the 'H' flag in the readout or trace information area.

[LOCAL] KEY

The [LOCAL] key does not have an associated menu structure. It is used to return the instrument to local (front panel) operation after being put into the remote (GPIB controlled) state by a GPIB controller. This is the only front panel key that is not disabled when the instrument is remotely controlled over the GPIB. The exception to this is when local lockout is in effect; this is a remote command that disables the [LOCAL] key making it difficult to interfere with the MTS while it is under remote control.

This key is also used to access the Edit Macro Menu when in the macro recording mode (see page 3-252).

[PRESET] KEY

The [PRESET] key provides a menu which enables the instrument to be set to a known condition.

Fig. 3-82 PRESET Menu

PRESET

Preset

Default Settings — Returns the instrument to its default set-up conditions. A complete listing of the default conditions is provided in Appendix A.

Default & Run Macro — Presets the instrument to its default state (as above), but additionally it will then run a macro named "preset" (the name can be either upper or lower case).
This soft key will be unselectable if the macro is not present, either internally or on a memory card.

Settings Store 10 — Sets the instrument to the conditions defined by the contents of settings store 10.
This soft key will be unselectable if setting stores 10 does not contain valid data.

Abort — Aborts the preset operation.

Chapter 4
TECHNICAL DESCRIPTION

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INTRODUCTION

The description which follows is intended as an overview of the 6200A Series MTS hardware, and relates to the functional blocks of the instrument as shown in Figs. 4-1 and 4-2, which are simplified block schematic diagrams of the instrument. Fig. 4-1 illustrates the 6203A (10 MHz - 26.5 GHz) MTS; the 6201A (10 MHz - 8 GHz) and 6200A (10 MHz - 20 GHz) are subsets of this structure. The 6204A is illustrated in Fig. 4-2, which differs mainly in the microwave chassis. The 6202A is an RF Test Set, designed to operate up to 2 GHz. Most of the Microwave components are not therefore required, as reflected in the block diagram of Fig. 4-3.

For a more detailed explanation of the instrument's hardware, refer to Chapter 1 of the Maintenance Manual.

SYNTHESIZER

The synthesizer module is responsible for generating the RF signals in the range 10 MHz to 2 GHz, and also provides the means of controlling and phase-locking the YIG tuned oscillators (YTO) which generate signals above 2 GHz. In addition, it contains the frequency standard circuitry, the power level control circuitry and the frequency counter hardware. The synthesizer functions are carried out by the RF PCB, Control PCB and Timebase PCB, but the operation of the synthesizer can be explained more effectively by not representing them separately on the block diagram.

The output of a 30 MHz voltage controlled crystal oscillator (VCXO) is divided down to give the various clock frequencies used within the synthesizer. If a 1 or 10 MHz external standard is selected, the VCXO is phase locked to it.

Two voltage controlled oscillators provide the coverage between 1 and 2 GHz. These are divided by 2 or 4 to give signals down to 250 MHz, and the 10 MHz to 250 MHz range is generated by a beat frequency oscillator (down converter). The synthesizer uses a programmable divider (using the Marconi Instruments patented fractional-N architecture) to allow high resolution whilst maintaining a high phase detector frequency. This permits a higher loop bandwidth and hence a faster settling time. A variable attenuator is used to control the level of the 10 MHz to 2 GHz signal, and the following amplifier boosts the signal to the required level.

The YTOs which generate signals above 2 GHz within the microwave chassis are sampled by a sampling gate mixer. The mixer is driven by a local oscillator signal provided by the divide-by-2 synthesizer path. The resultant IF signal is processed by a phase-locked loop circuit, whose output is used to drive the FM coils of the YTOs. This does not apply to the 6202A since there are no YTOs.

The sampling gate mixer is also used during frequency counter operation to generate an IF which is counted by the counter circuitry. If the signal is below 400 MHz direct frequency counting is employed (via the sampling gate).

MICROWAVE CHASSIS

The microwave chassis is responsible for signal generation above 2 GHz by means of one or more YTOs. The number of YTOs depends on the instrument version; one for the 6201A, three for the 6200A and four for the 6203A and 6204A. The 8-12 GHz and 12-20 GHz oscillators are followed by discrete low pass filters to reduce harmonics. The 2-8 GHz oscillator contains an integral tracking filter.

A PIN switch (SP4T for 6200A/6201A, SP5T for 6203A/6204A) selects one of its inputs, which includes the 10 MHz to 2 GHz signal generated by the synthesizer. The switch can be set so that none of the inputs are selected, and no RF signal appears at the output connector. A broadband directional coupler separates out part of the signal from the YTOs (i.e. frequencies above 2 GHz), which is sampled by the sampling gate mixer and used for phase locking as described earlier. The through path of the coupler is followed by a broadband modulator

which, together with the resistive pickoff (coupler on 6204A), diode detector and control circuitry in the synthesizer, form the levelling circuit. The modulator is set to minimum attenuation for frequencies less than 2 GHz, generated by the synthesizer. If fitted, the optional step attenuator is situated between the matching resistor and the RF OUTPUT connector.

When the frequency counter is in use, an SP2T switch routes the COUNTER input signal to the sampling gate, instead of the coupled YTO signal.

In the 6204A instrument (Fig. 4-2), the microwave chassis has additional components for the generation of signals between 26.5 and 46 GHz, i.e. a 13.25 - 23 GHz amplifier, a 23 GHz low pass filter and a frequency doubler. A DPDT PIN switch is used to switch these components into the RF path when RF signals in the range 26.5 - 46 GHz are required. A 46 GHz coupler and diode detector provide a levelling signal for outputs in the range 2 to 46 GHz; a resistive pickoff/detector is used for outputs below 2 GHz.

The 6202A is not required to generate frequencies above 2 GHz, so the microwave chassis does not contain any YTOs. The microwave chassis contains only a pickoff/switch assembly and a step attenuator, if this option is fitted. The pickoff/switch assembly contains a PIN diode switch to isolate the RF signal from the output connector when no RF output is required. This function is carried out by the SP4T (SP5T) switch in the other variants. A second PIN switch is used to isolate the COUNTER input from the sampling gate mixer when the counter function is not being used. The assembly also contains a resistive pickoff and diode detector, which provides a sample of the RF signal for use in the levelling circuit.

DIGITAL PCB

The Digital PCB provides all the main control and processing functions of the MTS. The processor used is the T805 transputer which is a 32-bit floating point processor operating at 20 MHz. Associated with this are 2 MBytes of dynamic RAM. The instrument's firmware is located in a block of EPROM. Non-volatile memory is provided by a block of battery backed static RAM (NOVRAM) which contains such things as instrument settings stores, and a block of EEROM which contains the fundamental calibration data for the MTS. A battery backed real time clock is also located on this board.

Other functional blocks provide the necessary control for the synthesizer module, Analogue PCB, Calibrator PCB and the keyboard.

Also located on the Digital PCB is the clock synchronisation circuitry. This consists of two phase locked loops which lock the 20 MHz transputer clock and the 22 MHz video clock to the 1 MHz reference clock generated from the frequency standard within the synthesizer.

Various input/output functions are handled by the Digital PCB including GPIB, PARALLEL PRINTER and VOLTAGE/CURRENT OUTPUT.

ANALOGUE PCB

The Analogue PCB contains two main areas of circuitry; the data acquisition and the graphics.

The data acquisition consists of four differential amplifier chains for inputs A, B, C and D. Each chain has two gain stages with eight ranges, the range changing being under hardware control. A reference and calibration DAC allows automatic calibration of each gain combination on each of the four amplifier chains. A noise reduction filter is used for slow sweeps. Sample-and-hold circuits for each chain allow simultaneous sampling of data on all four inputs. Each sample-and-hold is then multiplexed in turn to a 16-bit audio ADC whose output is fed to the Digital PCB. The circuitry for input D is slightly different in that it also generates the necessary power sensor chopper amplifier and zero drive circuitry. The AUX INPUT connection is used to receive detector inputs from the 6210 Reflection Analyzer.

The graphics circuitry is based around the 82786 graphics processor which has three main functions. Firstly, its drawing processor implements a range of drawing commands. Secondly, its DRAM controller manages all the timing and refresh signals for the 1 MByte of video memory associated with the graphics system. Thirdly,

its video controller generates the video sync signals for the optional external CRT monitor. Associated with the graphics processor is a second T805 floating point transputer and a further 1 MByte of DRAM. In addition to controlling the graphics processor the transputer performs many other processing functions. The colour palette and video drivers provide the RGB signals required by the external colour monitor.

The AUX DATA connection is used to transfer digital data between the MTS and the AUX DATA port of the 6210 Reflection Analyzer.

CALIBRATOR PCB

The Calibrator PCB consists of three functional blocks under the control of the Digital PCB. It generates the 50 MHz, 1 mW POWER REF signal used for calibrating the power meter sensors. It also provides control circuitry for the microwave chassis PIN switches (SP2T and SP4(5)T) and the optional step attenuator.

LCD INTERFACE PCB

The LCD Interface PCB contains an EPROM whose address inputs are provided by the graphics controller on the Analogue PCB. The EPROM contains the colour information required by the LCD module. The board also contains a crystal oscillator which provides a 25 MHz video clock for the graphics controller.

KEYBOARD PCB

The purpose of the Keyboard PCB is to handle the keypad and rotary control interfaces. An 8031 microcontroller is used to detect keypresses and rotary control movement; handle multiple keypresses, key bounce etc; pre-process rotary control information; communicate the information to the Digital PCB transputer via a serial link. The keyboard software is contained in EPROM.

COLOUR DISPLAY

The display is a VGA TFT colour LCD, with a resolution of 640 × 480 pixels.

POWER SUPPLY UNIT

The power supply is a switched mode unit and runs directly from the mains supply. After passing through a filter network the incoming mains supply is rectified and smoothed. Mains is also passed through a transformer to derive the power for the control circuitry. A PSU controller IC is used to generate a pulse width modulated waveform which drives the switching FETs. These FETs in turn switch the rectified mains line to the switching transformer. The outputs from the transformer secondaries are rectified and smoothed to provide the required output supplies for the instrument. Various status conditions are monitored within the PSU which drive status LEDs on the rear panel of the MTS. The AUX POWER connection is used to supply 25 V DC to the 6210 Reflection Analyzer.

6210 REFLECTION ANALYZER

INTRODUCTION

The description which follows is intended as an overview of the 6210 Reflection Analyzer hardware, which is illustrated in block diagram form in Fig. 4-4. It is shown in relation to the relevant functional blocks of the MTS, since control of the measurement and processing of the data is shared between the MTS and the 6210. For a more detailed explanation of the 6210 hardware, refer to Chapter 1 of the 6210 Maintenance Manual.

MICROWAVE CHASSIS

A functional description of the microwave circuit must be based on the mathematical techniques employed to process the measurement data derived from it. Since calibration is an integral part of the process, this is also covered. The following simplified discussion is intended only to acquaint the user with the measurement concept employed. It therefore describes the processes involved without going into a detailed and unnecessary mathematical analysis.

The 6210 uses the 6-port technique to determine the complex reflection coefficient at the input of the device to be measured (the S_{11} S-parameter), and it does this by making only scalar measurements. The 6-port is a microwave junction to which an RF source, four power detectors and the device under test (DUT) are connected.

The 6-port is physically realised using five 3 dB quadrature directional couplers. For these couplers, the phase of the coupled signal relative to the through output is 90° over the operating frequency range of the coupler. In addition, half the power is coupled from the through path to the coupled output. The couplers are arranged in such a way that one of the detectors monitors the source power and the other three receive different combinations of power both directly from the source and reflected from the DUT. The combinations are chosen in an optimum way so as to give the best measurement accuracy. (Only three power measurements are required to determine both magnitude and phase; the fourth one is used to resolve an ambiguity regarding the sign of the phase angle.)

The measurements obtained from three of the detectors are ratioed with the one monitoring the source. Since only power ratios are used in subsequent processing, the four detectors need only respond linearly with input power; absolute power accuracy is not a requirement.

At any given frequency there exists a unique mathematical relationship between the three power ratios and the reflection coefficient of the DUT. The power ratios are related to the reflection coefficient by three equations (the 6-port equations). From these, a single equation can be derived giving the reflection coefficient in terms of the power ratios, three real constants and four complex constants. The constants are dependant upon the characteristics of the 6-port hardware. Since each complex constant can be represented as two real numbers, a total of 11 constants describe the 6-port circuit.

Calibration of the 6-port circuit must be performed in order to evaluate these 11 constants. This is done by connecting devices with known reflection coefficients (called standards) to the 6-port, and then from the detector responses a set of equations can be formed and solved for the unknown constants. For various mathematical reasons, and also because of practical considerations in obtaining suitable standards, the following two-stage calibration process is adopted.

6 to 4 Port Reduction

This process evaluates five of the 11 constants referred to above; these five constants are referred to as reduction coefficients. This is done by mathematically converting the 6-port to operate like a pair of heterodyne channels in a conventional 4-port reflectometer. This results in an equation relating the detector power ratios to the five reduction coefficients.

This equation does not contain the reflection coefficient of the DUT associated with the detector responses, therefore the reduction coefficients can be found without the need for precision standards. However, because the equation is non-linear, a unique solution for the coefficients requires the generation of nine equations using nine different DUTs. The important point to note is that the five reduction coefficients can be found without

the need for precision standards. As long as the nine loads are different, their characteristics need not be known in order to determine the reduction coefficients. An automatic termination generator (ATG) is used to generate the nine different complex loads by switching in different attenuations and phase shifts.

The vector measurement of the reflection coefficient of the DUT can be expressed as a pair of real and imaginary values, which are functions of the resulting power ratios and the five reduction coefficients, which are now known.

4-Port Calibration

The vector measurement of the DUT as described above is subsequently calibrated to account for imperfect hardware. The reduced 6-port provides a vector indication analogous to that of a conventional 4-port and therefore the same calibration can be applied to it. The important difference is that an uncorrected 4-port can still give a reasonable measurement depending entirely on the hardware comprising it. The reduced 6-port, however, gives a vector measurement which is meaningless until corrected by 4-port calibration.

The true reflection coefficient of the DUT is related to the above vector measurement by an equation which has three error terms. These are complex constants characteristic of the hardware, and are concerned with correcting for directivity, source match and frequency response errors. These error terms are evaluated by measuring the reflection coefficients of three known DUTs (standards). This generates six linear equations with six real constants (two for each complex error term) and thus the error terms can be found. These error terms account for the remaining six constants that describe the 6-port circuit.

Only reflection standards are required for the 4-port calibration; typically, these are a short circuit, an open circuit and a fixed or sliding matched load. A sliding load is usually used above 2 GHz for better accuracy.

Subsequent to calibration, an unknown device can be evaluated from a knowledge of the error terms and the vector measurement. Note that evaluation of the 11 constants (5 real reduction coefficients plus 3 complex error terms) must be done for each frequency point of the sweep.

MAIN PCB

The data acquisition system comprises four differential amplifiers which are used to interface with the diode detectors in the microwave chassis. A 12-bit DAC and level shifting circuitry are used to provide offset correction for each channel. The differential amplifier outputs are passed to the MTS second stage amplifiers via the AUX INPUT connector on the MTS front panel. Automatic range changing is performed via control lines passed via the AUX DATA connector.

A temperature control circuit is used to maintain the microwave chassis at a constant temperature, since otherwise thermal drift would result in measurement errors. Three separate control loops are used. Two of them maintain a constant temperature at thermally sensitive locations within the 6-port circuit, while a third loop controls the ambient air temperature within the 6210.

The digital circuitry contains two transputers and associated DRAM which provide the computing capability required for the 6-port calculations (i.e. the six-to-four port reduction and the 4-port calibration). The circuit also provides the control lines for the data acquisition system and the Automatic Termination Generator within the 6-port. The code for the transputers is resident in the MTS, and is downloaded to the 6210 at power-on.

PSU PCB

Power for the 6210 is derived from the 25 V DC input received from the MTS via the AUX POWER connector. A 50 W DC-DC converter, synchronised to the MTS 125 kHz clock, is used to convert this to the DC supplies required by the Main PCB. Three high efficiency switched mode regulators are used to provide regulated DC supplies of 5 V, +15 V and -15 V. Various status conditions are monitored within the PSU, which drive status LEDs on the rear panel of the 6210, and will shut down the unit under these fault conditions.

Block Schematic Diagram 6200/1/3

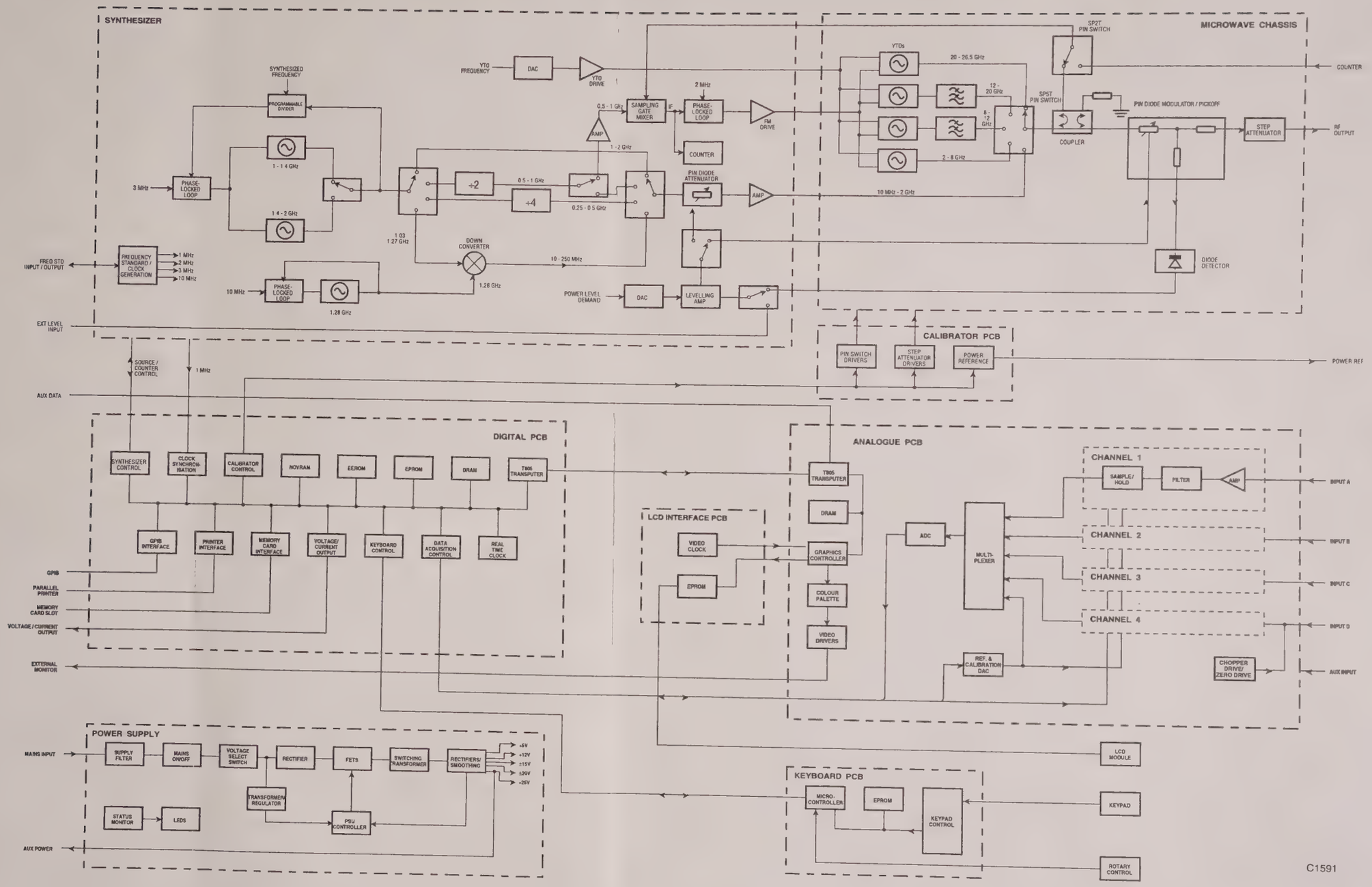

Fig. 4-1 Block Schematic Diagram of the MTS (6200/6201/6203)

Block Schematic Diagram **6204**

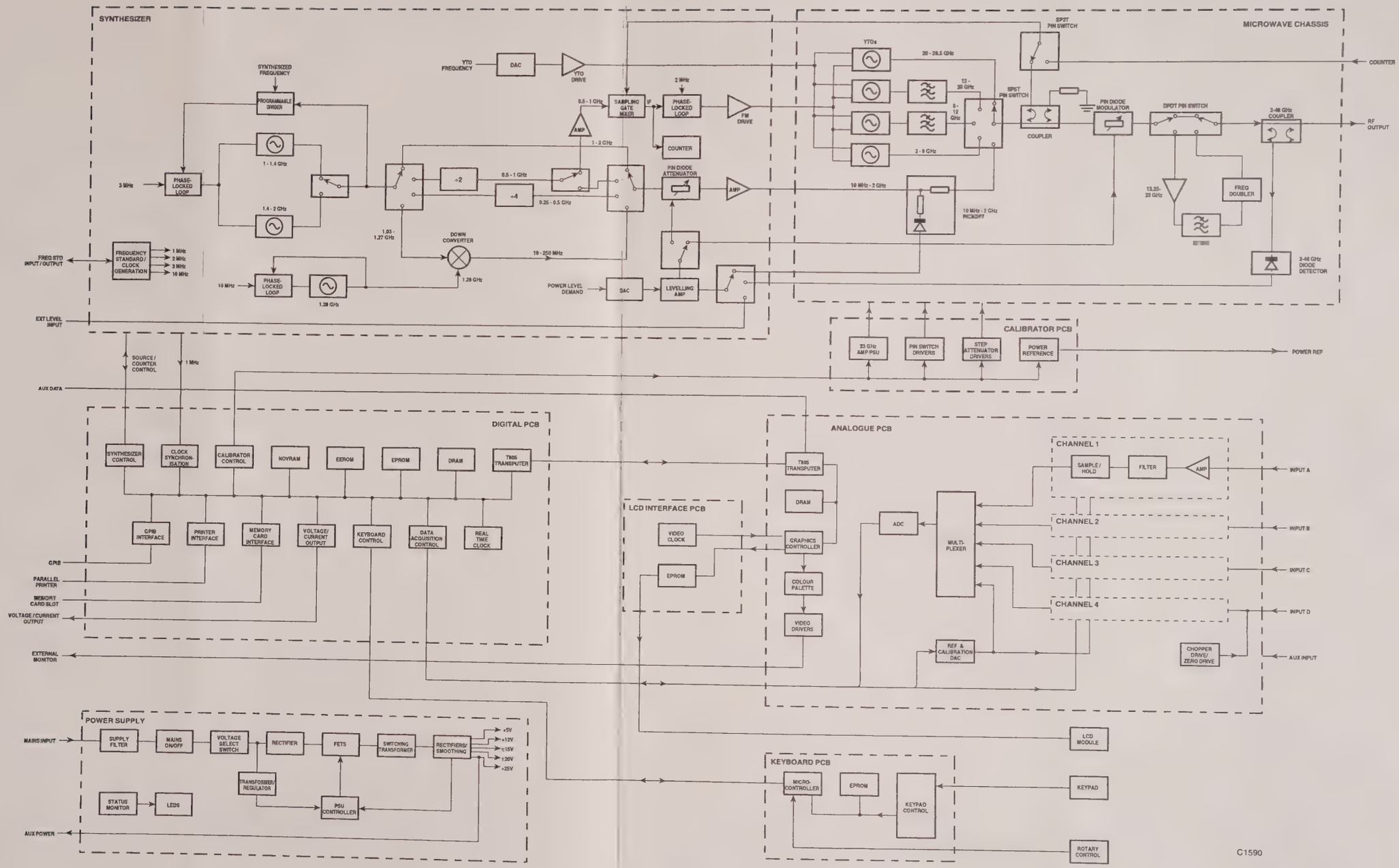

Fig. 4-2 Block Schematic Diagram of the MTS (6204)

Block Schematic Diagram 6202

4-12

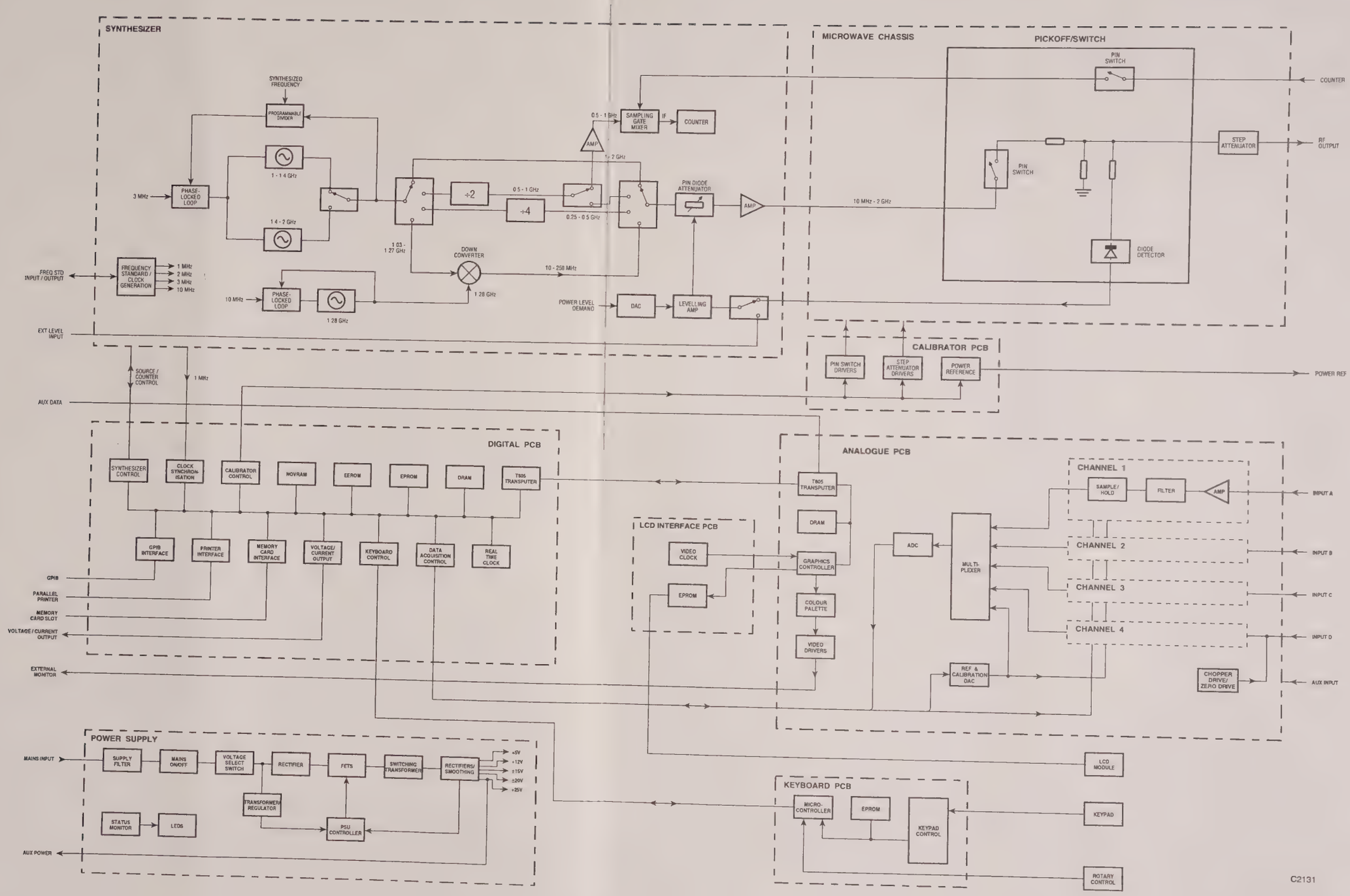

Fig. 4-3 Block Schematic Diagram of the 6202 RF Test Set

Block Schematic Diagram 6210

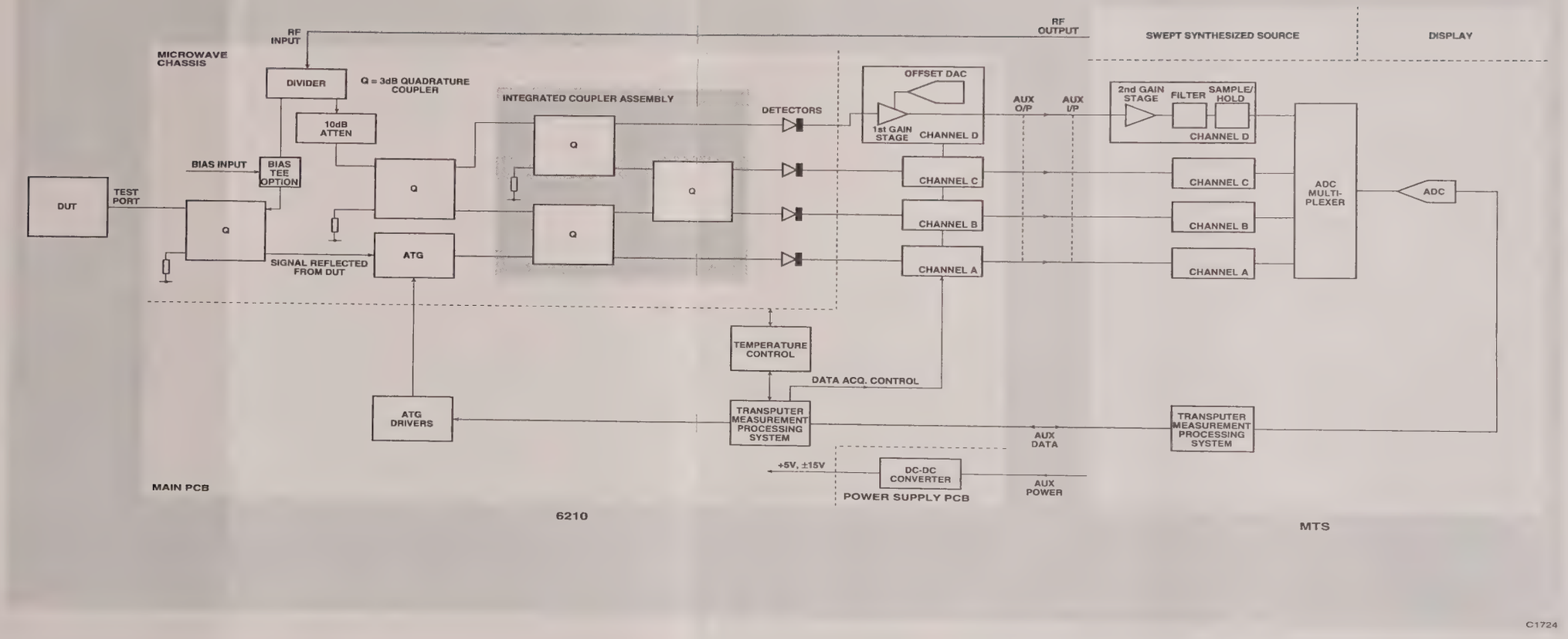

Fig. 4-4 Block Schematic Diagram of the 6210

Chapter 5
ACCEPTANCE TESTING

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INTRODUCTION

Test procedures described in this chapter may be simplified and of restricted range compared with those that relate to the generally more comprehensive factory test facilities which are necessary to demonstrate complete compliance with the specifications.

Performance limits quoted are for guidance and should not be taken as guaranteed performance specifications unless they are also quoted in the Performance Data in Chapter 1.

When making tests to verify that the instrument meets the stated performance limits, allowance must always be made for the uncertainty of the test equipment used.

SOURCE CW FREQUENCY ACCURACY

SPECIFICATION

Frequency range

6200A	10 MHz to 20 GHz
6201A	10 MHz to 8 GHz
6203A	10 MHz to 26.5 GHz
6204A	10 MHz to 46 GHz

CW accuracy

10 MHz to 26.5 GHz	±50 Hz ± frequency standard accuracy
26.5 GHz to 46 GHz	±100 Hz ± frequency standard accuracy

TEST EQUIPMENT

Description	Minimum specification	Example
Frequency counter	**For 6200A:** Range 10 MHz to 20 GHz	MI 6200A
	For 6201A: Range 10 MHz to 8 GHz	MI 6201A
	For 6203A: Range 10 MHz to 26.5 GHz	MI 6203A
	For 6204A: Range 10 MHz to 46 GHz Accuracy ±25 Hz or better	EIP 538B with Option 6 plus remote sensor 097

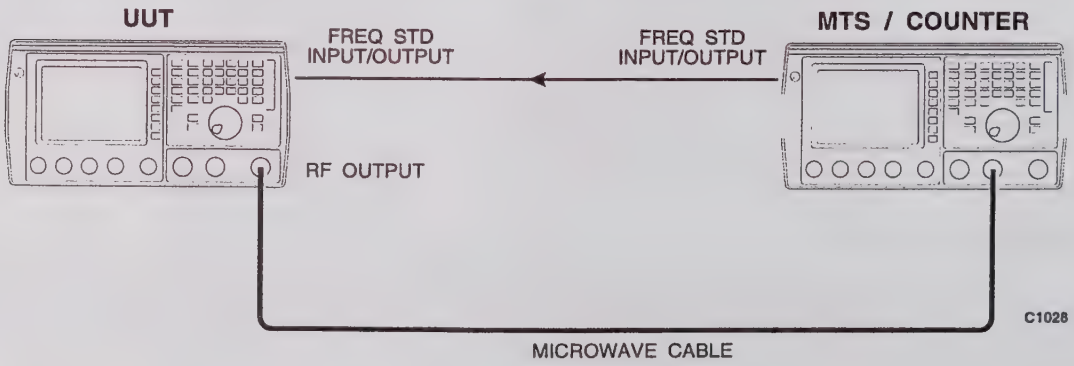

Fig. 5-1 CW Frequency Accuracy Setup

(1) Connect the equipment as shown in Fig. 5-1. If using a microwave counter, this should be on internal timebase, with the timebase output connected to the UUT.

(2) Put the test MTS into counter mode by selecting:

[PRESET]
[Default Settings]
[Readout]
[MEASURE]
[Counter]

or

select the appropriate input channel on the microwave counter.

(3) Put the UUT into source only mode with external frequency standard, by selecting:

[PRESET]
[Default Settings]
[SOURCE]
[Select Source Mode]
[CW]
[Return to Source]
[Source Functions]
[Source Only Mode]
[Levelling & Freq Std]
[Ext Std 10 MHz]
[SOURCE]
[Set Output Power]
...verify that this is 0.00 dBm
[RF]
[Set Frequency...]

(4) Ensure that the **XSTD?** indicator is **not** present on the top line of the UUT display, which would be the case if the UUT had not locked onto the external standard.

(5) Set the UUT to the frequencies listed below (as appropriate to the frequency range of the UUT), and check that the frequency count is within the specified limits. Because of the link between the UUT and the test MTS, the frequency limits are independent of the frequency standard accuracy.

Frequency	Lower limit	Upper limit
10.000 000 MHz	9.999 950 MHz	10.000 050 MHz
249.999 999 MHz	249.999 949 MHz	250.000 049 MHz
250.000 001 MHz	249.999 951 MHz	250.000 051 MHz
349.999 999 MHz	349.999 949 MHz	350.000 049 MHz
350.000 001 MHz	349.999 951 MHz	350.000 051 MHz
499.999 999 MHz	499.999 949 MHz	500.000 049 MHz
500.000 001 MHz	499.999 951 MHz	500.000 051 MHz
699.999 999 MHz	699.999 949 MHz	700.000 049 MHz
700.000 001 MHz	699.999 951 MHz	700.000 051 MHz
999.999 999 MHz	999.999 949 MHz	1 000.000 049 MHz
1.000 000 001 GHz	0.999 999 951 GHz	1.000 000 051 GHz
1.399 999 999 GHz	1.399 999 949 GHz	1.400 000 049 GHz
1.400 000 001 GHz	1.399 999 951 GHz	1.400 000 051 GHz
1.999 999 999 GHz	1.999 999 949 GHz	2.000 000 049 GHz
2.000 000 001 GHz	1.999 999 951 GHz	2.000 000 051 GHz
7.999 999 999 GHz	7.999 999 949 GHz	8.000 000 049 GHz
8.000 000 001 GHz	7.999 999 951 GHz	8.000 000 051 GHz
12.399 999 999 GHz	12.399 999 949 GHz	12.400 000 049 GHz
12.400 000 001 GHz	12.399 999 951 GHz	12.400 000 051 GHz
19.999 999 999 GHz	19.999 999 949 GHz	20.000 .000 049 GHz
20.000 000 001 GHz	19.999 999 951 GHz	20.000 000 051 GHz
26.499 999 999 GHz	26.499 999 949 GHz	26.500 000 049 GHz
26.500 000 001 GHz	26.499 999 901 GHz	26.500 000 101 GHz
40.000 000 000 GHz	39.999 999 900 GHz	40.000 000 100 GHz
46.000 000 000 GHz	45.999 999 900 GHz	46.000 000 100 GHz

SOURCE LEVEL ACCURACY

SPECIFICATION

Internal levelling accuracy
(including flatness at 0 dBm)

Standard and Option 002

10 MHz to 26.5 GHz	<±1 dB, <±0.5 dB typical*
26.5 GHz to 40 GHz	<±1.5 dB, <±0.7 dB typical*
40 GHz to 46 GHZ	<±3 dB typical*

*Typical performance limits are non-warranted.

TEST EQUIPMENT

Description	Minimum specification	Example
Power meter	Worst case accuracy not greater than ±0.2 dB, excluding mismatch error	MI 6200A series
Power sensor	**For 6200A:** Range 10 MHz to 20 GHz N-type connector	MI 6910
	For 6201A: Range 10 MHz to 8 GHz N-type connector	MI 6910
	For 6203A: Range 10 MHz to 26.5 GHz PC-3.5 connector	MI 6913
	For 6204A: Range 10 MHz to 46 GHz 2.92 mm connector	MI 6914

Note...

When making power measurements it is convenient to have the sensor's Cal Factor data stored in instrument memory. Although it is possible to use the UUTs own power meter to check source level accuracy, it is unlikely to have a Cal Factor data table saved in its memory for the sensor used in this test. Unless such data is available on a memory card it is more straightforward to use an external power meter. In this test then, the test MTS is used as an external power meter and contains a Cal Factor table for the sensor in use.

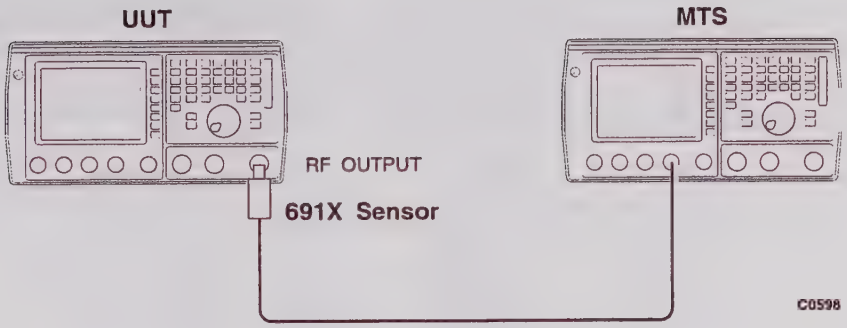

Fig. 5-2 Level Accuracy and Linearity Setup

(1) Connect the power sensor to Input D of the test MTS and its POWER REF output.

(2) Put the test MTS into power meter mode by selecting:

[PRESET]
[Default Settings]
[Readout]
[MEASURE]
[General Set-up]
[Sensor Correction]
[Cal Factor User Freq]
[Select Cal Factor Table...] *

* The test MTS should have a power sensor calibration data table stored for the sensor in use. See Chapter 3 for more details.

(3) Connect the power sensor to the test MTS POWER REF output and perform a sensor ZERO and CAL as follows:

[CAL]
[Sensor Cal]
[Continue]

Now connect the sensor to the UUT RF OUTPUT, as in Fig. 5-2.

(4) Set up the UUT as follows:

[PRESET]
[Default Settings]
[CAL]
[Det/Sensor zero]
[Detector Autozeroing] (OFF)
[SOURCE]
[Select Source Mode]
[CW]
[Return to Source]
[Set Output Power...]
...verify that this is 0.00 dBm
[RF]
[Set Frequency...]

(5) Set the UUT to the frequencies listed below (as appropriate for the frequency range of the UUT). At each point, select the same frequency on the test MTS using *[Set Frequency...]* under the Sensor Corr sub-menu, so that the power meter applies the appropriate Cal Factor correction. Check that the source level accuracy is within the specified limits, but note that the limits given do not include mismatch error, which should be allowed for in this measurement.

10.00 MHz	8.05 GHz	20.70 GHz	28.50 GHz
1.15 GHz	9.20 GHz	21.85 GHz	30.80 GHz
2.30 GHz	10.35 GHz	23.00 GHz	33.10 GHz
3.45 GHz	11.50 GHz	24.15 GHz	35.40 GHz
4.60 GHz	12.65 GHz	25.30 GHz	37.70 GHz
5.75 GHz	13.80 GHz	26.45 GHz	40.00 GHz
6.90 GHz	14.95 GHz		
	16.10 GHz		
	17.25 GHz		
	18.40 GHz		
	19.55 GHz		

*Performance limits non-warranted.

Hint...

Set a frequency increment value of 1.15 GHz for points above 1.15 GHz, and 2.3 GHz for points above 26.5 GHz.

(6) Leave the equipment set up and proceed to the next test, SOURCE POWER LINEARITY.

SOURCE POWER LINEARITY

SPECIFICATION

Linearity ±0.5 dB over guaranteed power range relative to 0 dBm

Guaranteed power range

6200A/6201A/6203A standard			Power levelled (dBm)
0.01	to	2 GHz	-10 to +7
2	to	8 GHz	-10 to +6
8	to	20 GHz	-10 to +5
20	to	26.5 GHz	-10 to +4

6204A			
0.01	to	2 GHz	-10 to +6
2	to	8 GHz	-10 to +5
8	to	18 GHz	-10 to +5
18	to	20 GHz	-10 to +5
20	to	26.5 GHZ	-10 to +3
26.5	to	40 GHz	-10 to +0
40	to	46 GHz	-10 to -3 typical

For option 002 (field replaceable RF connector) guaranteed output is reduced by 0.5 dB.

TEST EQUIPMENT

Description	Minimum specification	Example
Power meter	Worst case accuracy not greater than ±0.2 dB excluding mismatch error	MI 6200A / 6201A / 6203A / 6204A
Power sensor	**For 6200A:** Range 10 MHz to 20 GHz -10 to +7 dBm N-type connector	MI 6910
	For 6201A: Range 10 MHz to 8 GHz -10 to +7 dBm N-type connector	MI 6910
	For 6203A Range 10 MHz to 26.5 GHz -10 to +7 dBm PC-3.5 connector	MI 6913
	For 6204A: Range 10 MHz to 46 GHz 2.92 mm connector	MI 6914

(1) If necessary, set up the equipment as described in steps (1) to (4) of the SOURCE LEVEL ACCURACY test.

(2) Set the UUT to each of the frequencies and power levels listed in the table below and record the power meter reading at each point.

(3) Calculate the error between the set power level and the measured power for each of the readings taken above. At each frequency, determine the relative error with respect to 0 dBm; this should be within ±0.5 dB.

Frequency	-10 dBm		-5 dBm		0 dBm		Max*	
	Meas	Error	Meas	Error	Meas	Error	Meas	Error
1 GHz								
4 GHz								
10 GHz								
16 GHz								
22 GHz								
34 GHz								

* Maximum guaranteed power depends on frequency and option; refer to specification.

SOURCE LEVEL ACCURACY AT 0 DBM - WITH OPTION 001 (STEP ATTENUATOR)

This test is identical to the SOURCE LEVEL ACCURACY test for standard versions. See previous section.

SOURCE LEVEL ACCURACY - WITH OPTION 001 (STEP ATTENUATOR)

SPECIFICATION

Option 001
(including option 002 if fitted)

10 MHz to 8 GHz	±1 dB ±0.3 dB ±2% of attenuator setting in dB
8 GHz to 26.5 GHz	±1 dB (±1 dB or 4% of attenuator setting in dB, whichever is greater)

Guaranteed power range

Option 001

	Power levelled (dBm)
0.01 to 2 GHz	-80 to +5
2 to 8 GHz	-80 to +4
8 to 18 GHz	-80 to +3
18 to 20 GHz	-80 to +2
20 to 26.5 GHz	-80 to +1

For option 002 (field replaceable RF connector) guaranteed output is reduced by 0.5 dB.

For this test there are two alternative methods. The first uses a signal generator calibrator and is the method recommended for the best possible accuracy. Where such a calibrator is not available, an alternative method is given using a detector and MTS scalar channel. Although this does not give the same degree of accuracy, it will provide a reasonable level of confidence in the performance of the step attenuator.

TEST EQUIPMENT

Description	Minimum specification	Example
Signal Generator Calibrator	**For 6200A:** 10 MHz to 18 GHz 0 to -80 dBm	Weinschel VM-4B
	For 6201A: 10 MHz to 8 GHz 0 to -80 dBm	Weinschel VM-4B
	For 6203A: 10 MHz to 18 GHz 0 to -80 dBm 18 GHz to 26.5 GHz 0 to -70 dBm	Weinschel VM-4B 1611 Frequency Extension Unit

Following the manufacturer's operating instructions, use the signal generator calibrator to measure the UUT RF level at a number of power settings and frequencies. For information, the ranges over which each attenuator pad is effective is given below.

Power O/P setting (dB)	Pad 1 20 dB	Pad 2 10 dB	Pad 3 20 dB	Pad 4 20 dB
Max o/p -10.50	OUT	OUT	OUT	OUT
-10.51 -19.99	OUT	IN	OUT	OUT
-20.00 -29.99	OUT	OUT	IN	OUT
-30.00 -39.99	OUT	IN	IN	OUT
-40.00 -49.99	OUT	OUT	IN	IN
-50.00 -59.99	OUT	IN	IN	IN
-60.00 -69.99	IN	OUT	IN	IN
-70.00 -80.00	IN	IN	IN	IN

METHOD 2

Note...

This method assumes that the scalar analyzer section of the UUT has been verified to be functioning correctly.

TEST EQUIPMENT

Description	Minimum specification	Example
Scalar detector	Frequency range to match UUT	6230

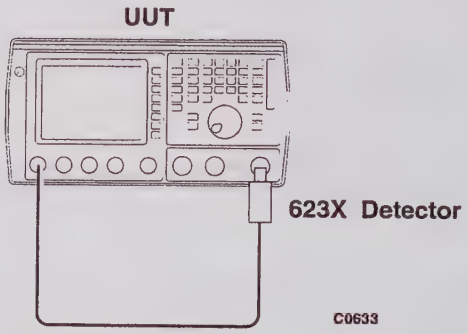

Fig. 5-3 Step Attenuator Accuracy Set-up, Method 2

Note...

Avoid unnecessary handling of the detector, which can cause thermal drift and result in measurement errors, particularly at low power levels.

(1) Connect the equipment as shown in Fig. 5-3, then set up the scalar channel as follows:

[PRESET]
[Default Settings]
[CAL]
[Det/Sensor Zero]
[Zero Detectors]
[SOURCE]
[Sweep Time]
[User Set Sweep Time]
[Set Sweep Time...]
[2] [×1] *(2 second sweep)*
[MEASURE]
[General Set-up]
[AC Detection]
[Return to Measure]
[Averaging]
[Set Averaging Number]
[1] [6] [×1] *(average 16 sweeps)*
[Averaging] (ON)
[Return to Measure]
[Smoothing]
[Set Aperture]

[1] [0] [x1] *(10% smoothing aperture)*
[Smoothing] (ON)
[SCALING]
[Continuous Autoscale]

(2) Perform a Through Path Cal on the detector at 0 dBm as follows:

[SOURCE]
[RF] (ON)
[CAL]
[Through Path Cal]
[Continue]

(3) Now perform the following key sequence, setting the source output to the levels shown in the table below:

[SOURCE]
[Set Output Power...]
... enter required level
[MEASURE]
[Restart Averaging]

This method effectively tests the frequency response of the step attenuator, independent of the levelling loop response. Consequently, the test limits are as shown in the table below. To account for measurement uncertainty, detector accuracy and VSWR mismatch uncertainty must be added to the given limits.

Level set (dBm)	Limits (dB)	
	10 MHz - 8 GHz	8 - 26.5 GHz
-11	±0.5	±1.0
-20	±0.7	±1.0
-40	±1.1	±1.6
-60	±1.5	±2.4

VOLTAGE/CURRENT SOURCE TEST

SPECIFICATION

Voltage output

Range:	-15 V to +15 V
Accuracy:	±15 mV

Current output

Range:	-150 mA to +150 mA
Accuracy:	±300 µA

TEST EQUIPMENT

Description	Minimum specification	Example
Digital multimeter	Voltage accuracy ±0.01% Current accuracy ±0.02%	Solartron 7150plus

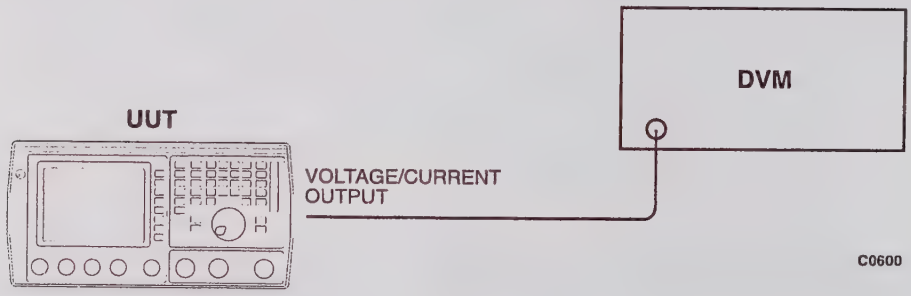

Fig. 5-4 Voltage/Current Source Accuracy Setup

(1) Connect the VOLTAGE/CURRENT OUTPUT connector on the UUT rear panel to the multimeter voltage input and select DC volts.

(2) On the UUT select:

[PRESET]
[Default Settings]
[SOURCE]
[Source Functions]
[Voltage/Current O/P]
[Constant Voltage]
[Set Voltage...]

(3) Select the voltages listed below and check that the measured values are within the specified limits:

+15 V
+10 V
+ 5 V
0 V
- 5 V
-10 V
-15 V

(4) Re-connect the VOLTAGE/CURRENT OUTPUT to the multimeter current input and select DC current.

(5) Now select:

[Constant Current]
[Set Current...]

(6) Select the currents listed below and check that the measured values are within the specified limits:

+150 mA
+100 mA
+ 50 mA
0 mA
- 50 mA
-100 mA
-150 mA

SCALAR ANALYZER SYSTEM ACCURACY

The scalar analyzer system accuracy specifications and performance tests depend upon the type of detector or return loss bridge in use. Refer to the appropriate instruction manual for details of these tests.

SCALAR ANALYZER DYNAMIC RANGE (NOISE FLOOR)

SPECIFICATION

AC detection	80 dB (-60 to +20 dBm)
DC detection	70 dB (-50 to +20 dBm)

TEST EQUIPMENT

Description	Type
Scalar detector	6230 series e.g. MI 6230, 6233, 6234
Parallel printer	Epson FX series, or printer with Epson FX emulation HP DeskJet 500/500C/550C HP LaserJet 4L or 4P Canon BJ series

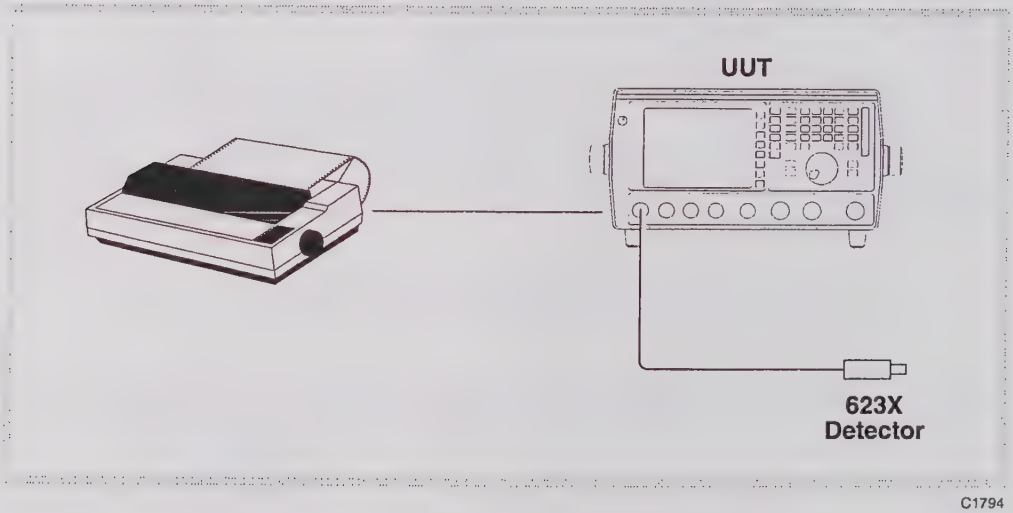

Fig. 5-5 Scalar Analyzer Dynamic Range Setup

This test determines the dynamic range by measuring the noise floor level of the scalar analyzer, since the top end of the dynamic range is fixed by the maximum permitted input level of +20 dBm.

(1) Connect a 6230 series detector to input connector A. Connect the printer to the PARALLEL PRINTER connector on the MTS rear panel. Press [COPY]*[Select Printer]*; this accesses a menu which allows you to specify the type of printer that is connected.

(2) Set the measurement configuration as follows:

[PRESET]
[Default Settings]
[MEASURE]
[General Set-up]

[Input Configuration]
[All Inputs are Scalar]
[MEASURE]
[Averaging]
[Set Average Number...]
[6] [4] [×1]
[Averaging] (ON)
[SOURCE]
[Set Number of Points...]
[2] [0] [×1]
[Sweep Time]
[User Set Sweep Time]]
[1] [.] [5] [×1]

(3) In order to minimize the possibility of thermal drift affecting the measurement, allow at least a few minutes after handling the detector for its temperature to stabilize. Now zero the detector and restart the averaging:

[CAL]
[Det/Sensor Zero]
[Zero Detectors]
[MEASURE]
[Restart Averaging]

(4) Wait for completion of the averaging cycle, which is indicated by the averaging flag changing from **a** to **A**. Now produce a list of the readings taken at each of the 20 measurement points on the printer:

[COPY]
[Tabular Print]

(Avoid a long pause between zeroing the detector and printing the results. If necessary, re-zero the detector.)

(5) The level of the noise floor can now be determined by computing the average (mean) of the 20 measurements. This should be less than the level specified above for DC detection.

(6) Switch to AC detection as follows:

[MEASURE]
[General Set-up]
[AC Detection]

Repeat steps (3) to (5) and check the result against the specification for AC detection.

(7) The previous steps should be repeated for each of the remaining three inputs B, C and D. These are selected as follows:

[MEASURE]
[Single Input A, B, C or D]
[B]
etc...

POWER METER POWER REFERENCE OUTPUT ACCURACY

SPECIFICATION

Accuracy ±1.2% worst case for 1 year

TEST EQUIPMENT

Description	Minimum specification	Example
Milliwatt power meter	Meter error ±0.015 dB at 50 MHz, 23°C ±3°C 50 Ω N-type probe connector Input VSWR <1.01:1 Calibrated to National Standards	W & G EPM-1

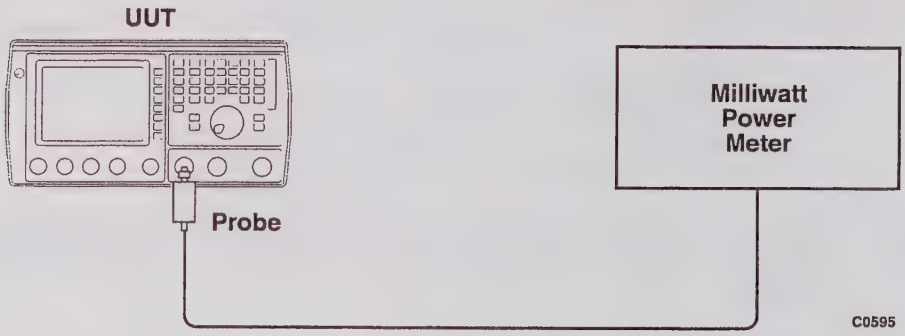

Fig. 5-6 Power Reference Accuracy Setup

Note...

For maximum accuracy it is important to allow sufficient warm-up time for the equipment used in this test. In the case of the EPM-1 this is 1 hour.

(1) Calibrate the milliwatt power meter, then connect the probe to the UUT POWER REF output (Fig. 5-6).

(2) On the UUT select:

[PRESET]
[Default Settings]
[CAL]
[Det/Sensor Zero]
[Detector Autozeroing] (OFF)
[Return to Cal]
[Power Ref] (ON)

(3) Verify that the reading on the milliwatt power meter is within ±1.2% (±0.05 dB).

POWER METER SENSOR AUTO-ZERO SET AND CAL CHECK

SPECIFICATION

Auto-zero set

6910 series	±200 nW
6920 series	±100 pW
6930 series	±6 µW

TEST EQUIPMENT

Description	Type
Power sensor	6910 series e.g. MI 6910, MI 6913
Power sensor	6920 series e.g. MI 6920, MI 6923
Power sensor	6930 series e.g. MI 6930

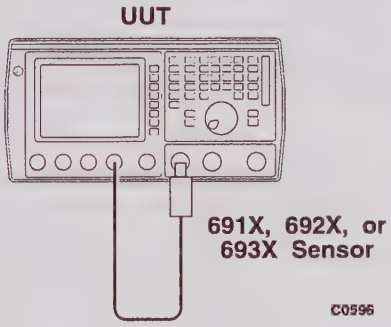

Fig. 5-7 Sensor Auto-Zero Set and Cal Check Setup

(1) Connect a 6910 series power sensor to input connector D using a sensor cable. Then connect the sensor to the POWER REF output.

(2) Select power meter mode in Watts and maximum averaging:

[PRESET]
[Default Settings]
[Readout]
[FORMAT]
[Watts]
[MEASURE]
[Averaging]
[Input D]
[User Set Averaging]
[Set Average Number...]
[1] [0] [0] [0] [×1]
[CAL]
[Det/Sensor Zero]
[Detector Autozeroing] (OFF)
[Return to Cal]
[Sensor Cal]

Determine the sensor's 50 MHz Cal Factor and Lin Factor values from the sensor's Cal Factor label or Calibration Record sheet. For the 6910 series this will always be the default value of 100%. Enter these values now, using *[Set Cal Factor...]* and *[Set Lin Factor...]*. Then perform the sensor calibration by pressing:

[Continue]

(3) When the sensor autozero and calibration are complete, select:

[MEASURE]
[Restart Averaging]

Wait for completion of the averaging cycle, which is indicated by the averaging flag changing from a to A, then verify that the displayed reading is less than 200 nW (6910 series), or the specified value for other sensors.

(4) Now select:

[CAL]
[Power Ref]
[MEASURE]
[Restart Averaging]

(5) Wait until four digits are present and check that the displayed reading is in the range 995.0 µW to 1.005 mW (or 995.0 nW to 1.005 µW for 6920 series) indicating successful completion of the sensor calibration.

(6) Repeat the test for any other sensors which are to be used with the MTS under test (the supplied 30 dB attenuator is required for 6920 series sensors).

COUNTER ACCURACY AND SENSITIVITY

SPECIFICATION

Frequency range

6200A	10 MHz to 20 GHz
6201A	10 MHz to 8 GHz
6203A/6204A	10 MHz to 26.5 GHz

Accuracy (readout mode): ±25 Hz ± frequency standard error

Sensitivity

25 MHz to 10 GHz	< -20 dBm typical*
10 GHz to 20 GHz	< -15 dBm typical*
20 GHz to 26.5 GHz	< -10 dBm typical*

*Typical performance limits are non-warranted.

TEST EQUIPMENT

Description	Minimum specification	Example
	For 6200A:	
Synthesized generator	Range 10 MHz to 20 GHz -10 to 0 dBm	MI 6200A option 001*
*Attenuator (optional for standard 6200A)	10 dB, N-type connectors flatness < ±1 dB	Weinschel model 44-10
	For 6201A:	
Synthesized generator	Range 10 MHz to 8 GHz -10 to 0 dBm	MI 6201A option 001*
*Attenuator (optional for standard 6201A)	10 dB, N-type connectors flatness < ±1 dB	Weinschel model 44-10
	For 6203A/6204A:	
Synthesized generator	Range 10 MHz to 26.5 GHz -10 to 0 dBm	MI 6203A option 001*
*Attenuator (optional for standard 6203A)	10 dB, 3.5 mm connectors flatness < ±1 dB	Weinschel model 9-10

Note...

Since the source accuracy of the MTS is typically ±25 Hz ± frequency standard error, it can be used to measure the frequency accuracy of the counter.

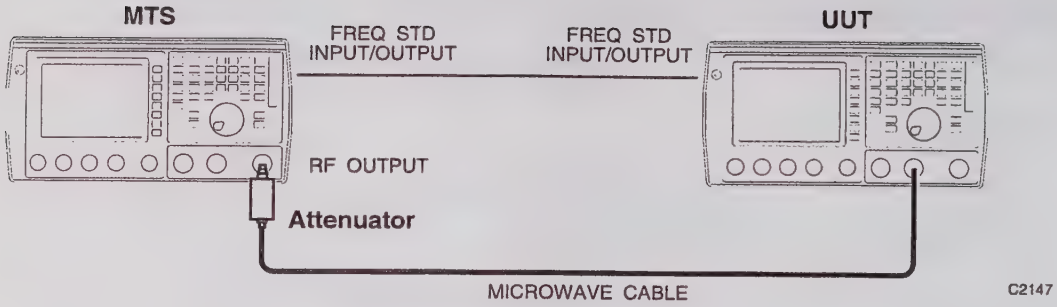

Fig. 5-8 Counter Accuracy & Sensitivity Setup

(1) Connect the equipment as shown in Fig. 5-8.

(2) Put the UUT into counter mode by selecting:

[PRESET]
[Default Settings]
[Readout]
[MEASURE]
[Counter]

(3) Set up the test MTS in source only mode and external frequency standard, by selecting:

[PRESET]
[Default Settings]
[SOURCE]
[Select Source Mode]
[CW]
[Return to Source]
[Source Functions]
[Levelling & Freq Std]
[Ext Std 10 MHz]
[Return to Source Func]
[Source Only Mode] (ON)
[Return to Source]

(4) Set up the test MTS source to the frequencies below and turn on the RF:

[SOURCE]
[Set Frequency...]
[RF] (ON)

Now adjust the power level, *[Set Output Power...]* to the specified levels. It will be necessary to allow for loss in the microwave cable. Suggested source power settings for a typical 1 metre cable are given in the table below. If in doubt, check the power level using the power meter.

Check that the UUT shows the correct count within the specified limit (at the frequencies appropriate to the UUT).

Frequency	Typical Sensitivity	Typical Cable Loss	Suggested Set Output Power
25 MHz	-20 dBm	0 dB	-20 dBm
1 GHz	-20 dBm	0.3 dB	-19.7 dBm
3 GHz	-20 dBm	0.5 dB	-19.5 dBm
6 GHz	-20 dBm	0.8 dB	-19.2 dBm
9 GHz	-20 dBm	1.2 dB	-18.8 dBm
10 GHz	-15 dBm	1.2 dB	-13.8 dBm
13 GHz	-15 dBm	1.5 dB	-13.5 dBm
16 GHz	-15 dBm	1.8 dB	-13.2 dBm
19 GHz	-15 dBm	2.1 dB	-12.9 dBm
20 GHz	-10 dBm	2.1 dB	-7.9 dBm
23 GHz	-10 dBm	2.3 dB	-7.7 dBm
26.5 GHz	-10 dBm	2.5 dB	-7.5 dBm

The following tests permit the noise floor and residual calibration errors to be determined. The tests are written as general procedures; the equipment used to perform the tests will depend upon the required degree of accuracy.

To test the 6210 to its full specification requires both a 7 mm Full Calibration Kit (for maximum directivity) and a 3.5 mm Full Calibration Kit (for full frequency range). Since the accuracy of calibration depends on the type of calibration kit employed, the use of a full calibration kit with a sliding load is strongly recommended. In practice however, the minimum requirement is to perform the tests with the type of calibration kit with which the instrument is actually to be used. It may then be tested to the specification corresponding to that kit.

TEST EQUIPMENT

Calibration Kit + Beadless Airline (in same connector type):

Connector type	Full kit (Sliding load)	Economy kit (Fixed load)	Airline
7 mm (18 GHz)	54424-001W	Not available	54424-001A
Type N (18 GHz)	54424-003T	54424-005X	54424-002D
3.5 mm (26.5 GHz)	54424-007C	54424-009B	54424-003H

PREPARE THE INSTRUMENT

The instrument should be switched on to warm up for at least 30 minutes, and preferably for 2 hours. First, press [PRESET] to set the instrument to the *[Default Settings]* state. Then set the [CHANNEL MODE] to *[Reflection Analyzer]*. Unless a previous calibration can be automatically recalled, a warning message will appear stating "Reflection analyzer calibration invalid". It is now necessary to set up the instrument parameters for the new calibration. This involves choosing functions from the [CAL]*[Reflection Analyzer Cal][Set up Calibration]* menu.

Enter Cal Kit parameters

If this is the first time that this particular Calibration Kit has been used, it may be necessary to enter the Calibration Kit parameters into the instrument. These parameters are printed on a card inside the calibration kit box. From the [CAL] menu, the *[Edit Cal Kit Data]* invokes a parameter editor. Further details are in the "FUNCTION (Reflection Analyzer)" section of this manual.

Set up the source parameters, averaging and detection mode

From the [CAL]*[Reflection Analyzer Cal][Set up Calibration][Set up Source]* menu, set the start frequency to 250 MHz and the stop frequency to 18 or 26.5 GHz. Set the power level to 3 dBm. Press *[Return to Cal][Averaging][Set Average Number]* and set the averaging factor to 8, and turn averaging on. Press *[Return to Cal][DC Detection]*. Then press *[Return to Reflect Cal]*.

SPECIFICATION

Noise Floor (dynamic range)

250 MHz to 500 MHz	>50 dB, 60 dB typical
500 MHz to 18 GHz	> 60 dB
18 GHz to 26.5 GHz	> 50 dB, 60 dB typical

From the Reflect Cal menu, press *[Select Cal Kit]* to choose the cal kit parameters that match the Calibration Kit that will be used. Select the sex of the calibration kit using the *[Male]* or *[Female]* soft keys. Choose the *[Short, Open, Fixed Load]* Calibration method. Press *[Measure Standards]*. If the upper frequency parameter for the fixed load is lower than your chosen stop frequency, the instrument will inform you now. Ignore this and confirm that you wish to proceed. Connect the three calibration standards in turn, and press *[Measure Standard]* for each one. **Make sure that the fixed load is the last item to be measured.** If anything is incorrectly connected, you may select any standard for re-measurement using the arrow soft keys.

After all three standards have been measured, press *[Process Measurements]*. **Do not remove the fixed load from the test port.** Press *[Select Store]* to choose the store number for the calibration data. Then press *[Save Calibration]*. Confirm that you wish to overwrite the old store if it is not empty. At this point, alter the Calibration ID if required. This is a label to enable easy identification of stored calibrations at a later time.

Now the instrument will be measuring the return loss of the fixed load. Since the calibration has assumed the fixed load to be reflectionless, and it has not been disconnected, the load should now be re-measured as reflectionless. The only contribution to the measurement is the noise floor of the 6210, which can be checked against the instrument specification. A typical trace is shown in Fig. 5-9.

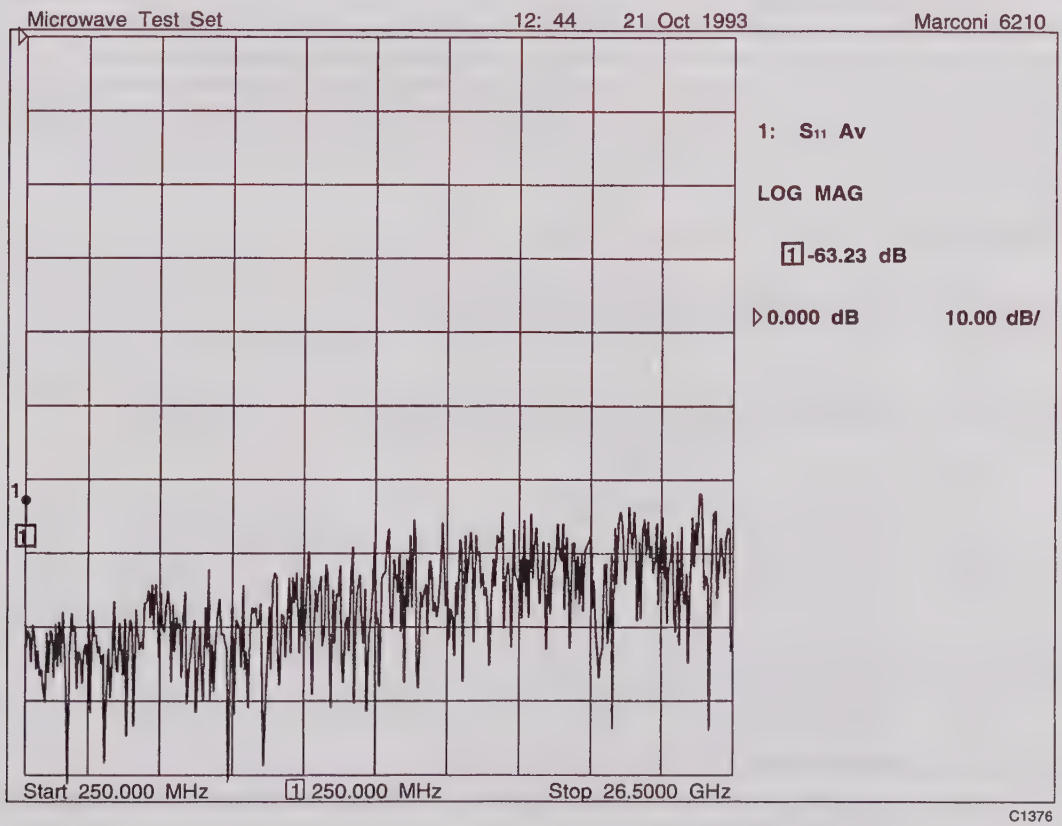

Fig. 5-9 6210 Noise Floor Measurement

DIRECTIVITY AND SOURCE MATCH TEST

SPECIFICATION

	7 mm Cal Kit (full)	3.5 mm Cal kit (full)
Directivity	>50 dB	>40 dB
Source Match	>40 dB	>30 dB

This test measures the residual directivity and source match errors present after calibration. There is a third residual error known as frequency response, which is due to the losses of the short circuit and the open circuit. These losses are immeasurably small with normal laboratory equipment, and are completely dominated by the directivity and source match errors. Therefore the frequency response error is not checked as part of this acceptance test.

The errors are directly related to the calibration kit employed, and therefore the tests should be repeated with every new calibration kit. If the calibration kit has no sliding load, follow the calibration procedure in the noise floor test above. Otherwise, perform a sliding load calibration according to the following instructions.

Calibration

From the [CAL] menu, press *[Reflection Analyzer Cal]*. Use *[Select Cal Kit]* to choose the cal kit parameters that match the Calibration Kit that will be used. Select the sex of the DUT that is to be measured using the *[Male]* or *[Female]* soft keys. Choose the *[Short, Open, Sliding Load]* calibration method. Press *[Measure Standards]*. Connect the short circuit, open circuit and fixed load in turn, and press *[Measure Standard]* for each one. If anything is incorrectly connected, you may select any standard for re-measurement using the arrow soft keys.

Extra care must be taken in connecting the sliding load. There are two methods for connection of the sliding load, although the construction of a particular sliding load may not permit both to be used. The zero gauge technique is more accurate. It involves setting up the centre conductor with a connector gauge and then mating it with the test port as if it were a standard connector. This requires a self - supporting centre conductor, which aligns properly with the test port. If the centre conductor is unsupported until it has been mated with the test port connector, then the centre conductor must be mated before the outer conductor. The following procedures should help to avoid damage :

Sliding Loads with Self - Supporting Centre Conductors

(1) Move the slider as far as it will go towards the connector (front) end and remove the centre conductor support from the sliding load connector.

(2) Set up an appropriate connector gauge and connect the sliding load to it.

(3) Carefully loosen the locking collet at the back end of the load, and adjust the centre conductor positioner so that the connector gauge reads zero.

(4) Remove the connector gauge.

(5) Hold the load with both hands. One hand should be on the centre conductor at the rear of the load, and the other at the front to guide the load towards the test port connector.

(6) Make sure that the load is squarely aligned with the test port, and offer it up to the centre conductor of the test port. Carefully do up the connector nut, WITHOUT rotating the load.

(7) Torque up the connector nut with the torque wrench, if provided in the Calibration Kit.

(8) Now proceed to make measurements of the sliding load positions. Each position is marked with a ring on the body of the load under the slider, except the first position where the slider is at the end of its travel nearest the Reflection Analyzer.

(9) Return the slider to the front-most position, untorque the connector, and remove the sliding load keeping it well supported.

(10) Replace the centre conductor support and return the sliding load to the cal kit.

Sliding Loads with Unsupported Centre Conductors

(1) Hold the sliding load horizontally at all times. The centre conductor will slide completely out of the back of the load if the locking collet is loosened.

(2) Move the slider as far as it will go towards the connector (front) end and remove the centre conductor support from the sliding load connector.

(3) Carefully loosen the locking collet at the back end of the load, and push the centre conductor forward as far as possible so that it protrudes from the connector at the front.

(4) Hold the load with both hands. One hand should be on the centre conductor at the rear of the load, and the other at the front to guide the load towards the test port connector.

(5) Make sure that the load is squarely aligned with the test port, and offer the centre conductor of the load up to the centre conductor of the test port. Gently push the centre conductor fully home.

(6) Now slide the body of the load over the centre conductor and locate it on the outer conductor of the test port. Carefully do up the connector nut, WITHOUT rotating the load.

(7) Torque up the connector nut with the torque wrench, if provided in the Calibration Kit.

(8) Check that the centre conductor is still fully home, and tighten the locking collet.

(9) Now proceed to make measurements of the sliding load positions. Each position is marked with a ring on the body of the load under the slider, except the first position where the slider is at the end of its travel nearest the Reflection Analyzer.

(10) Return the slider to the front-most position, untorque the connector, and remove the sliding load keeping it well supported.

(11) Unlock the centre conductor, push it forward out of the connector as far as possible and then lock it in place. Replace the centre conductor support and return the sliding load to the cal kit.

Press *[Measure Standard]* for each sliding load position. After all standards have been measured, press *[Process Measurements]*. Press *[Select Store...]* to choose the store number for the calibration data. Then press *[Save Calibration]*. Confirm that you wish to overwrite the old store if it is not empty. At this point, alter the Calibration ID if required. This is a label to enable easy identification of stored calibrations at a later time.

Directivity Test

Connect a precision beadless airline terminated with a fixed load to the test port. Marconi Instruments full calibration kits are optionally supplied with an airline suitable for this purpose. The following notes are intended to help avoid damage to the airline.

(1) Do not touch the centre conductor with bare hands since finger grease attracts dust and causes corrosion. Use either finger cots or lint-free gloves for protection.

(2) Make sure that the centre conductor never has to support its own weight by the collet.

(3) 3.5 mm and N-type airlines require the inner conductor to be mated at one end before the outer is slid over and the nut hand-tightened.

(4) 7 mm airlines are supplied with spring-loaded centre conductors, which should be located in the centre collet of the mating connectors. Insert the centre conductor inside the outer conductor before making any connections.

(5) 3.5 mm airlines have a retractable nut on the male end. It is therefore easiest to make this connection last, having connected the other end first.

(6) Connection is easier if the test port is vertical, so that gravity does not cause the centre conductor to sag. The 6210 can be operated on its rear feet, or a flexible test port cable may be used. This is particularly important for non-retracting N-type airlines where the inner and outer conductors must both be connected to the test port before connecting the termination.

(7) After connecting the airline finger-tight, check the measured response for unexpected behaviour before torquing up the connectors. Resonances and high reflection may indicate an incorrectly located centre conductor. Torque the connectors in sequence beginning at the test port to avoid rotation of the airline.

The directivity measurement is best done with the linear magnitude format. From the [FORMAT] menu, press *[Lin Mag]*. A typical trace is shown in Fig. 5-10.

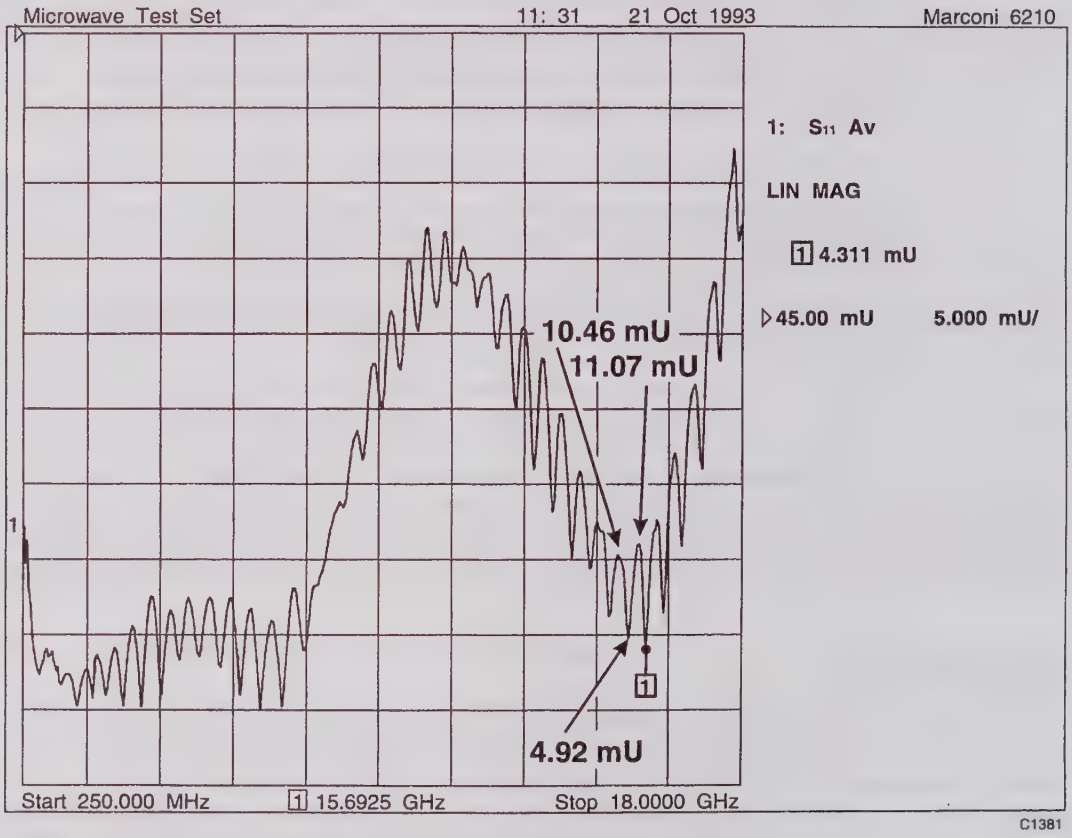

Fig. 5-10 6210 Directivity Measurement

The trace is composed of two vectors which alter in relative phase as the frequency is swept. The residual directivity error shows as a reflection at the test port due to the airline. The airline is assumed to be of higher precision than the 6210 calibration, and so the reflection present is the error to be quantified during this test. The second vector is due to the reflection of the fixed load which terminates the airline. Since this is phase shifted by two trips through the airline, its phase component is much more frequency sensitive than the directivity error, and so a ripple pattern is formed as the frequency is swept. We expect the directivity error to be smaller than the reflection of the fixed load, and so the average value through the ripples corresponds to the reflection of the load, and the peak deviation of the ripple from the average corresponds to the directivity error.

To calculate the directivity at any frequency, use the following calculation:

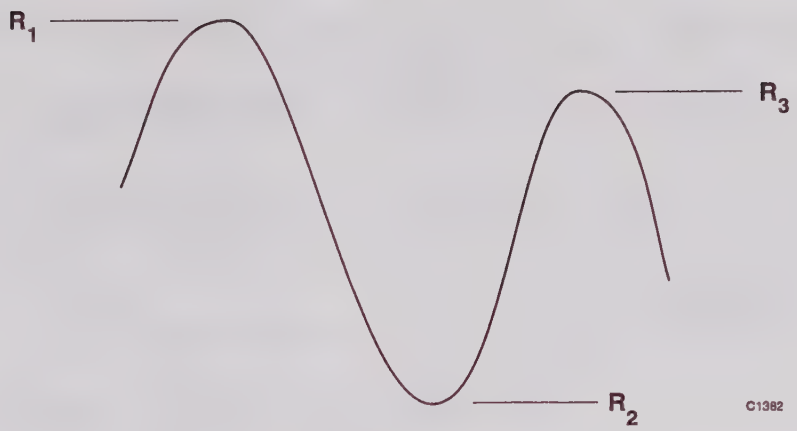

Fig. 5-11 Directivity Calculation

$$\text{Directivity (dB)},\ D = -20\log\left(\frac{\frac{R_1}{2}+\frac{R_3}{2}-R_2}{2}\right)$$

where R_1, R_2, and R_3 are linear magnitudes of reflection coefficient.

For the example shown in Fig. 5-10, the directivity is

$$D = -20\log\left(\frac{\frac{0.01046}{2}+\frac{0.01107}{2}-0.00492}{2}\right) = 50.68\ \text{dB}$$

Source Match Test

Using the calibration obtained in 'Calibration' above, connect a precision beadless airline terminated with a short circuit to the test port. Follow the connection hints given in 'Directivity Tests' above. The source match measurement is best done with the linear magnitude format. From the [FORMAT] menu, press *[Lin Mag]*. A typical trace is shown in Fig. 5-12.

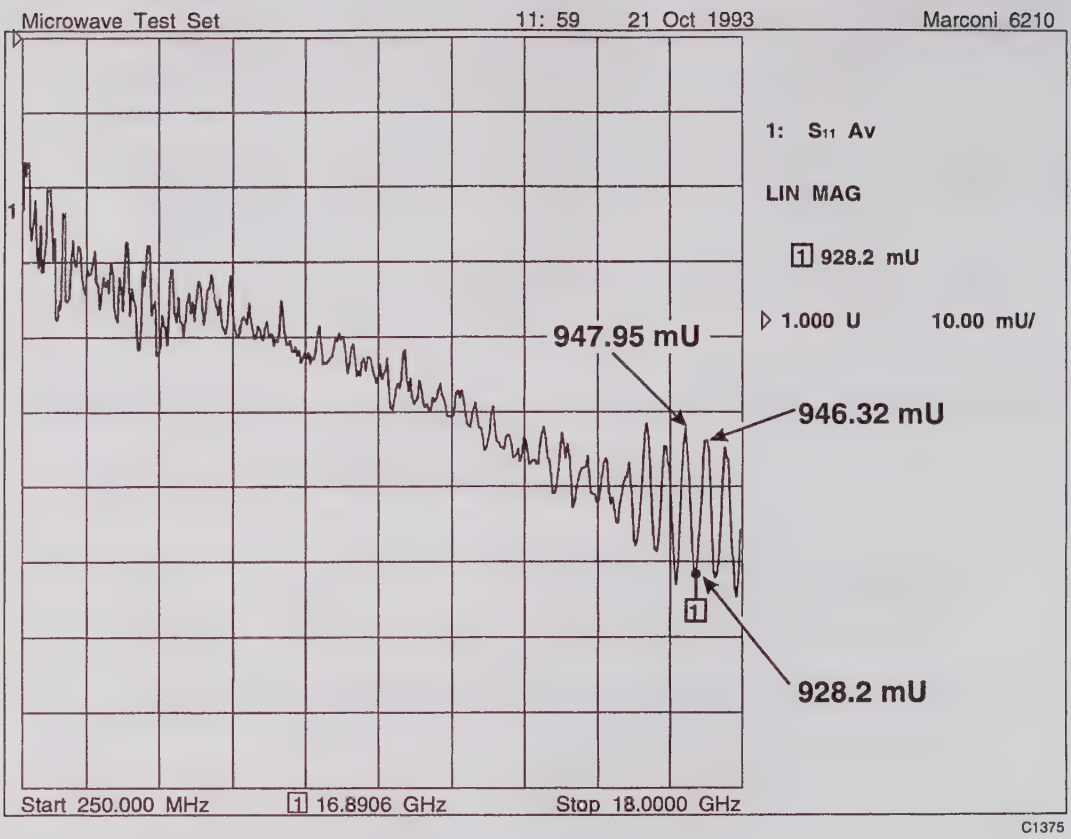

Fig. 5-12 6210 Source Match Measurement

The trace is similar to the directivity measurement in that it is composed of two vectors which alter in relative phase as the frequency is swept. The major reflection is due to the short circuit terminating the airline. The second vector is due to a re-reflection of some of the return signal from the short circuit off the test port, which is measured after reflecting off the short circuit a second time. Since this is phase shifted by two extra trips through the airline, its phase component is much more frequency sensitive than the direct short circuit reflection, and so a ripple pattern is formed as the frequency is swept. We expect the source match error to be smaller than the reflection of the short circuit, and so the average value through the ripples corresponds to the reflection of the short circuit, and the peak deviation of the ripple from the average corresponds to the source match.

To calculate the source match at any frequency, use the following calculation:

$$\text{Source Match (dB)},\quad S = -20\log\left(\frac{\frac{R_1}{2}+\frac{R_3}{2}-R_2}{2}\right)$$

where R_1, R_2, and R_3 are linear magnitudes of reflection coefficient defined in Fig. 5-11.

For the example shown in Fig. 5-12, the source match is

$$S = -20\log\left(\frac{\frac{0.94795}{2}+\frac{0.94632}{2}-0.9282}{2}\right) = 40.48\,\text{dB}$$

Appendix A
INSTRUMENT DEFAULT SETTINGS

The default settings of the most commonly encountered instrument parameters are given below. These are the settings that exist after the [PRESET] *[Preset to Default Settings]* key has been pressed.

Parameter	Value/State
Number of Channels	1
Active Channel No.	1
Active Channel Mode	Scalar
Non-Active Channel Mode	Scalar
Channel Coupling	On
Channel Domain	Frequency
Frequency Scale Factor	1
Frequency Offset	0
Frequency Annotation Removed	No
Hard Copy Options	All options enabled (except set-up conditions)
Source Mode	Start/Stop Frequency Sweep
Start Frequency	10 MHz
Stop Frequency	Maximum
Number of Points	401
Power Level	0 dBm
External Source Control	Off
Voltage/Current O/P Mode	Constant voltage , 0 V
RF	Off
Sweep Time	Auto
Detector Correction	Automatic
Input Offsets	0 dB
Number of Measurements	1
Active Measurement No.	1
Active Measurement Definition	Input A
Non-Active Meas Definition	Input A

For both active and non-active measurements:

Averaging	Off
Averaging No.	16
Smoothing	Off
Smoothing Aperture	5%
Path Cal	Off
Memory Operation	Off
Format	dBm
Reference Position	Line 10 (top)
Reference Level	20 dBm
Scale	10 dB/div
Fault Location Reference Level	0 dB
Continuous Autoscale	Off
Limit Checking	Off
Default Screen Title	"Microwave Test Set"
Measurement Title	Off
Default Measurement title	"Measurement 1"

eBay: Mess

Active Marker	On
Active Marker No.	1
Non-Active Markers	Off
Active Marker Position	10 MHz

If the channel mode for either channel is changed to READOUT:

Active Measurement	Input D
Averaging Control	Auto
Averaging On/Off	On
Power Reference	Off
Max/Min Hold	Off
Limit Checking	Off
Duty Cycle Correction	Off
Format	dBm
Cal Factor Origin	Manual Cal Factor
Cal Factor	100%
Linearity Factor	8

If the channel mode for either channel is changed to REFLECTION ANALYZER:

Source Start Frequency	250 MHz
Display Start Frequency	250 MHz
Source Stop Frequency	26.5 GHz or maximum, whichever is lower
Display Stop Frequency	as above
Time Domain Domain	Time
Time Domain Start	-1 ns
Time Domain Stop	4 ns
Time Domain Transform Type	Band Pass
Time Domain Response	Impulse
Impulse Response Format	Lin Mag
Step Response Format	Real
Time Domain Windowing	Normal
Measurement Definition	S_{11}
Averaging	Off
Format	Log Mag
Reference Position	Top
Reference Level	0 dB
Scale Factor	5 dB/div

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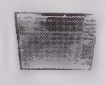


Do these photos violate eBay policies? Let us know

From: ridge_equipment
To: acctg-buyer
Subject: Re: ridge_equipment sent a message about Marconi / IFR 6100A + 6110 RF Modulated Test Set (Item [illegible])
Sent Date: Aug 18 14 [illegible]:50:15 PDT

Dear acctg-buyer,

Here are the tracking r

UPS Package 1 Track
UPS Package 2 Track

- ridge_equipment

From: acctg-buyer
To: ridge_equipment
Subject: Re: ridge_equ
Sent Date: Aug-18-14 1

Dear ridge_equipme

Dear Ridge-equipment

Thank you for the infor

Thank you.

Monica S

- acctg-buyer

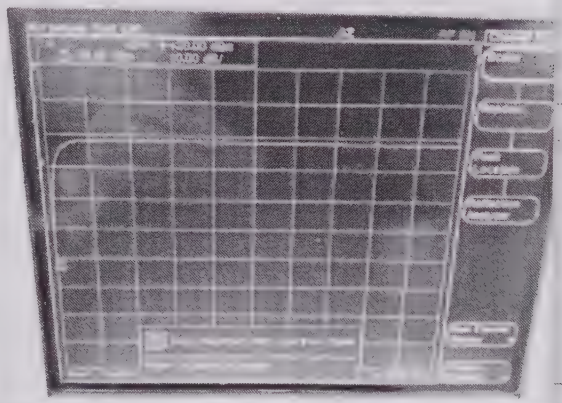
From: ridge_equipment
To: acctg-buyer
Subject: Re: ridge_e
Sent Date: Aug 18 14

Dear acctg-buyer,

We have shipped your
in the smaller , black c

Les W
Ridge Equipment
410-871-2273

6200 error message 2014-08-25.jpg



Appendix B
ERROR MESSAGES

This Appendix lists in alphabetical order all the errors that can be reported to the user via the display. The errors are grouped as follows:

System Failure. This usually implies a hardware fault or corruption of data in a non-volatile store.

Instrument Warning. This is a warning to the user that the instrument is being used incorrectly.

Data Warning. This is a warning that the data that has been input is inappropriate.

C0278

Other Errors. This group contains those errors for which the other three groupings do not apply.

An icon as shown above will be displayed on the screen to inform the user of the type of error that has been detected.

SYSTEM FAILURE

Data acquisition calibration failure

This is the error sent when calibration fails or gives unexpected results. The user may continue operating the instrument, but measurement accuracy may be impaired.
For further information refer to the Maintenance Manual.

Data acquisition main amp failed

The data acquisition system has reported failure of the main amplifier. The user may continue operating the instrument, but measurement accuracy may be impaired.
For further information refer to the Maintenance Manual.

Data acquisition zero operation failed

The data acquisition system has reported a zero failure. To find which input has failed, select Data Acquisition Diagnostics and check for an offset DAC set to either 0 or 4095.
For further information refer to the Maintenance Manual.

Frequency standard calibration failure

Frequency standard calibration failure report. The user may continue operating the instrument, but measurement accuracy may be impaired.
For further information refer to the Maintenance Manual.

Instrument serial number is invalid

Before a software option can be installed, the integrity of the EEPROM store containing the instrument's serial number is checked. This error occurs if the serial number is invalid

Power supply overheating

Power supply status report.
Switch off and allow to cool. Check that the air vents are not blocked. Switch on and check that the fan is running. If the problem persists, switch off and refer to the Maintenance Manual.

Reflection analyzer calibration failure (4 port calibration)

The 4 port calibration has failed during processing of the reflection analyzer calibration data.

Reflection analyzer calibration failure (Reduction)

The 6 to 4 port reduction has failed during processing of the reflection analyzer calibration data.

Self-test failed

A failure has occurred during power-on selftest. A record of the test results is stored in non-volatile memory. This error message advises the user to examine the self-test results.
Examine power-on test results: [UTILITY]*[Service][Status][Display Test Results].*

Source cal failure

If an error occurs during calibration of the source, the following information will be displayed, according to the cause of the failure. The user may continue operating the instrument, but measurement accuracy may be impaired.

If the source power cal fails:

Frequency = nnn MHz
Level DAC = nnnnn
Error Code = n

Failure during collection of flatness data:

Linearity Frequency = nnn MHz
Frequency = nnn MHz
Level DAC = nnnnn
Error Code = n

Failure in the frequency calibration:

Frequency = nnn MHz
Tuning DAC = nnnnn
Error Code = n

If 'Halt On Error' has been selected from the Diagnostics menu, the error message will be 'Source cal failure - halt on error set'.
For further information refer to the Maintenance Manual.

Store corrupted

Before data is extracted from a store, the checksum that was stored with the data is recalculated. This error message is displayed if a checksum error has been detected for the specified internal memory or external memory card store. It will not be possible to use the contents of a store if the checksum is invalid. Corrupted stores are marked empty or overwritten with default data as appropriate. This error should not occur in normal use.
If the error occurs frequently refer to the Maintenance Manual.

INSTRUMENT WARNING

AC detection not permitted when ext source enabled

AC detection is not permitted when an external source is enabled because it is not possible to synchronise the RF on/off switching between the two sources. The MTS selects DC detection automatically.

AC detection not permitted when power meter levelling enabled

AC detection is not permitted when power meter levelling is enabled. DC detection is selected automatically.

Active marker not enabled

A request to move the active marker has been received, but the active marker is not switched on.
To enable, use: [MARKERS]*[Active Mkr].*

Ambient temperature changed. Scalar detector zero required.

The ambient temperature in which the instrument is operating has changed sufficiently to require a scalar detector zero.
Ensure that RF is not being applied to the detectors, then zero using: [CAL] *[Det/Sensor Zero] [Zero Detectors].*

Transmission line database card not present

The transmission line database card is not present. The operation that was requested cannot be actioned or the current operation is aborted.

Transmission line database card present

The transmission line database card cannot be formatted as a stores extension card.

Cal piece incompatible with selected cal type

A GPIB command has been received that requests the MTS to measure a cal piece that does not match the selected cal type. For example, an attempt has been made to measure a sliding load when a fixed load cal type has previously been selected.
Check the pieces required for the selected cal type.

Cannot access cal piece

A GPIB command has been received to read or write a cal kit parameter that is not present in the section of the cal kit store previously addressed with the REFlect:CALibration:KIT:CONNector command.
Address correct section of cal kit store using: REFlect:CALibration:KIT:CONNector

Cannot complete short/open path calibration

Between storing the SHORT measurement data and averaging in the OPEN measurement data, the number of measurement points has changed. This error can only occur when the instrument is under GPIB control.

Cannot control external source

User has tried to enable external source control while the instrument GPIB mode is Talker/Listener.
Set GPIB to Controller Mode using: [UTILITY] *[GPIB].*

Cannot plot

User has tried to invoke a plot (from the keyboard) while the instrument GPIB mode is Talker/Listener.
Set GPIB to Controller Mode using: [UTILITY]*[GPIB].*

Cannot process reflection analyzer cal data

The REFlect:CALibration:PROCess GPIB command has been sent before all the required cal pieces have been measured.

Cannot select source-only mode

Source-only mode cannot be selected because the current source mode is either waveguide, low pass or linear list.

Cannot transfer narrowband cal to primary

Only broadband user calibrations may be transferred to the primary calibration store.

Channel coupling not permitted

Channel coupling is not permitted because at least one channel is configured as a fault location or reflection analyzer channel.

Chart recorder not available on external source

It is not permitted to set the voltage/current output mode of the external source to chart recorder.

Chart recorder output aborted

This is a warning that the mode of the voltage/current output has changed, and that the chart recorder output due at the end of the current measurement has been aborted.

Command inconsistent with cal kit

A GPIB command has been received that is inconsistent with the connector type held in the cal kit.

Copy not yet complete

You have attempted to initiate new hard copy without waiting for the previous hard copy to complete.
To abort use: [COPY]*[Abort Copy].*

Delta marker not enabled

A request to move the delta marker has been received, but the delta marker is not switched on.
To enable, use: [MARKERS]*[Delta Marker].*

Digital sweep commands not permitted

GPIB digital sweep commands have been received while the MTS is not in source-only mode.
Set the instrument to source-only mode: [SOURCE]*[Source Functions].*

Display format not permitted

Only dB and VSWR formats are permitted for fault location channels.
Select either dB or VSWR format.

Duplicate device addresses

You have attempted to locate a GPIB device (plotter, external source, etc.) at an address that is already assigned to a device.
Choose another address for the device.

Duty cycle correction not permitted for frequency measurements

Duty cycle correction may only be applied to power measurements.

Errors occurred during macro execution

During macro execution errors can easily disappear from the screen before they are read. A mechanism for error logging is provided during macro execution. If an error occurs during macro execution when error logging is on, an error will be displayed on the screen to tell the user to examine the error log.
Examine the macro error log using: [MACRO]*[View Error Log].*

External frequency standard not present

The instrument has been configured to accept an external frequency standard, but no signal is present at the FREQ STD INPUT/OUTPUT connector.
Check the connection to the FREQ STD INPUT/OUTPUT connector, or select internal standard: [SOURCE]*[Source Functions][Levelling & Freq Std].*

External source not found

You have selected external source control but a source (e.g. a second MTS) has not been found at the specified GPIB address.
Check external source GPIB address and cable.

Fault location calibration invalid

This message is displayed when a channel is first defined to be a fault location channel, and the calibration is therefore invalid.
Use [MEASURE] *to set up the measurement, then use* [CAL] *to calibrate the system.*

The message is also displayed if the fault location calibration has been invalidated because one or more parameters affecting the measurement has changed.
Perform new calibration or recall original conditions using: [MEASURE]*[Recall Cal Conditions].*

Fault location option not installed

A GPIB command or a key press associated with fault location has been received, but the required software option has not been installed.

Format incompatible with the active measurement definition

An attempt has been made to use a display format incompatible with the current measurement. Examples include attempting to set Watts format when making a ratio measurement, setting VSWR format when measuring absolute power, or setting watts format for a reflection analyzer channel.

Frequency measurement not permitted

Swept measurements of frequency require voltage or current domain.
First select voltage or current domain: [SOURCE][Select Source Mode].

GPIB activity aborted

You have switched the GPIB mode from controller to talker/listener. This has necessitated aborting the current GPIB activity (such as plotting) that is currently being controlled by the MTS.

GPIB transfer failed to complete

GPIB transfer initiated by MTS (acting as controller) failed to complete.
Check GPIB devices and cables.

Input configuration changed

If a channel is set to fault location mode, the instrument will assume that a transmission line test head is connected and set up the input configuration accordingly. This message will be displayed to warn the user that a pre-existing input configuration has been overridden.

Input A overloaded

Data acquisition has detected that the detector on input A is likely to be overloaded.
Reduce power incident on the device connected to input A.

Input B overloaded

Data acquisition has detected that the detector on input B is likely to be overloaded.
Reduce power incident on the device connected to input B.

Input C overloaded

Data acquisition has detected that the detector on input C is likely to be overloaded.
Reduce power incident on the device connected to input C.

Input D overloaded

Data acquisition has detected that the detector on input D is likely to be overloaded.
Reduce power incident on the device connected to input D.

Input D cannot be used for swept measurement

While a swept measurement involving Input D is being displayed, Input D has been reconfigured to accept a power meter sensor. Instrument reverts to an absolute power measurement from Input A.

Input D not configured for detector

A scalar detector has been connected to Input D, but Input D has been configured to accept a power sensor.
To configure Input D to accept a scalar detector:
[MEASURE]*[General Set-up][Input Configuration].*

Input D not configured for power sensor

A power sensor has been connected to Input D, but Input D has been configured to accept a scalar detector.
To configure Input D to accept a power sensor:
[MEASURE]*[General Set-up][Input Configuration].*

Input overload on reflection analyzer

Data acquisition has detected that the reflection analyzer hardware is likely to be overloaded.
Reduce RF source output power.

Key not selectable

Cannot alter medium whilst transmission line database in use

Whilst the transmission line database is in use, the user is not allowed to change the medium.

Key not selectable

Cannot alter parameters whilst transmission line database in use.

Whilst the transmission line database is in use, the user is not allowed to change any of the parameters set by the transmission line database.

Key not selectable

Channel coupling only available with scalar and readout channels

Channel coupling is not permitted because at least one channel is configured as a fault location or reflection analyzer channel.

Key not selectable

Channels must be coupled for this operation. To couple channels use: [CHANNEL MODE]*[Channel Coupling]*

Some operation require that channel coupling be enabled.

Key not selectable

Function incompatible with low-pass transform

Function (e.g. certain source modes) are not available when the low pass time domain is enabled.

Key not selectable

Function incompatible with polar or Smith formats

The function is incompatible with polar or Smith formats.

Key not selectable

Function not available when time domain measurements are enabled

Function (e.g. select polar or Smith format) is not available when time domain measurements are enabled.

Key not selectable

Function not permitted with linear list sweeps

Function (e.g. dB/Octave, dB/Decade) is not available when the source mode is set to linear list.

Key not selectable

Function only available with low-pass transform

This function is only available when the low pass transform has been selected.

Key not selectable

Function requires step response time domain measurements

Function (e.g. impedance format) is only available when step response time domain measurements are enabled.

Key not selectable

Function requires time domain measurements to be enabled

Function (e.g. find next peak) is only available when time domain measurements are enabled.

Key not selectable

Live fault location measurements may only be displayed on measurement 1, and trace memories only on measurement 2

Key not selectable

Low pass source mode must be selected before low pass transform

The low pass transform cannot be selected because the source mode is not low pass.

Key not selectable

Macro 'Preset' not present

To be able to run a macro immediately after preset, a macro named "Preset" must be present either internally or on a memory card.

Key not selectable

Measurement must be displayed in Log Mag format

The function (e.g. marker bandwidth search) requires the measurement to be displayed in Log Mag format.

Key not selectable

No transmission line data selected. Select from card or a transmission line database store

The transmission line database can only be enabled if data has been previously selected from either a transmission line database card or from one of the transmission line database stores.

Key not selectable

Operation incompatible with the active measurement format. Select a Cartesian log format

Some operations, for example bandwidth measurements, require the measurement to be displayed in log (i.e. dB or dBm) format.

Key not selectable

Parameter incompatible with coax medium

This parameter (e.g. waveguide cut-off frequency) cannot be set when the currently selected medium is coax.

Key not selectable

Parameter incompatible with waveguide medium

This parameter (e.g. delay time, relative velocity, or dielectric constant) cannot be set when the currently selected medium is waveguide.

Key not selectable

Select a swept frequency source mode

Function (e.g. Bandwidth) requires that the source mode is set to a swept frequency sweep.

Key not selectable

Settings store 10 is empty

To be able to recall from settings store 10, it must contain valid data.

Key not selectable

Source mode incompatible with time domain measurements

Certain source modes are incompatible with time domain measurements.

Key not selectable

Source-only mode is enabled. To disable, use: [SOURCE]*[Source Functions]*

Key not selectable

The display range must be greater than zero

Function (e.g. dB/Octave, dB/Decade) is only available when display stop domain is greater than start domain.

Key not selectable

The external source cannot support this operation

Some operations are not available for the external source. These include the selection of source-only mode or the chart recorder.

Key not selectable

The number of measurement points must be at least 40 before gating/fencing or time domain functions can be selected

The number of measurement points must be 40 or more before time domain or gating/fencing can be selected.

Key not selectable

The source stop domain must be greater than the source start domain before gating/fencing or time domain functions can be selected

Source stop domain must be greater than start domain before time domain or gating/fencing can be selected.

Key not selectable

The time domain software option is not installed

The key is not selectable because the Time Domain software option is not installed.

Key not selectable

This operation is incompatible with a counter measurement

Some operations are not available when the active measurement is a counter measurement. It is not possible, for example, to apply duty cycle correction to a counter measurement.

Key not selectable

This operation is incompatible with a trace memory display

Some operations are not available when the active measurement is a "memory" display. It is not possible, for example, to apply averaging to a memory.

Key not selectable

This operation is incompatible with the active channel domain. To change domain, use: [SOURCE] *[Select Source Mode]*

The source domain can affect the availability of operations. Swept counter measurements, for example, can only be performed when the domain is voltage or current.

Key not selectable

This operation is incompatible with the active channel mode. Use [SWITCH CHANNEL] to make the other channel active, or [CHANNEL MODE] to change mode

Some functions, e.g. find next peak right/left, depend on the active channel mode.

Key not selectable

This operation is incompatible with the active measurement. The measurement set-up may be changed via the [MEASURE] key

The choice of available formats depends of the measurement definition.

Key not selectable

This operation is incompatible with the domain of one or both channels.

Some operations are not allowed if the domain of either channel (whether active or not) is incompatible.

Key not selectable

This operation is incompatible with the Input D configuration. To change, use: [MEASURE][*General Set-up] [Input Configuration]*

Some operations depend on the configuration of input D. Examples include the use of the D input for scalar measurements, and the Cal and Zero Sensor functions.

Key not selectable

Waveguide measurements in the distance domain require a waveguide sweep

It is not possible to select distance domain if the medium is waveguide and the source mode is not waveguide sweep.

Key not selectable

Waveguide measurements in the time domain require a non-waveguide sweep

It is not possible to select distance domain if the medium is waveguide but the source mode is not waveguide sweep.

Limit checking not permitted with active measurement display format

Limit checking is only permitted on cartesian formats.
Select a cartesian format.

Linear list sweep not available for active channel mode

Linear list sweep mode is only available for reflection analyzer measurements. The MTS prevents this mode being selected for non-reflection analyzer channels, but the error could be generated as the result of a GPIB command or if the channel mode is switched from reflection analyzer to scalar.

Low pass sweep not available for active channel mode

Low pass sweep is only available for reflection analyzer measurements. The MTS prevents this mode being selected for other channel modes, but the error could be generated as the result of a GPIB command or if the channel mode is changed.

Macro buffer full

Buffer overflow occurred while recording a macro.
Restrict the number of keypresses to 50.

Macro nesting error

Macro calls have been nested too deep, or a macro has called itself.

Macro not found

The macro specified with a *Run Macro* control code does not exist.

Marker search failed

The marker search function has failed to find the search target value.

Marker tracking has been turned off

This is a warning that a change has forced marker tracking off, since it is incompatible with the format or channel domain.

Macro syntax error

Syntax error within a macro. After a Loop and Branch control code there should always be a Run Macro control code.

Measurement data invalid

An operation such as hold, save trace to memory, print or plot has been initiated before the whole trace contains valid data. The operation cannot be performed until the measurement update has completed.

Measurement definition incompatible with current format

The measurement definition has changed so that it is no longer compatible with the active measurement display format. This error could occur, for example, if the display format were Watts, and the measurement definition were changed to a ratio of inputs. If this error occurs the appropriate log format (dB or dBm) is selected.

Memory card changed

When a memory card is configured to provide additional stores, the MTS determines the memory capacity of the card present. This information is used to limit the total number of stores that can be requested. Before the configuration information is written to the memory card a check is again made to ensure that a new card of smaller size has not been inserted. If this error occurs the operation is aborted.

Memory card not present

The memory card needed for an operation (such as for configuration or software option installation) is not present. This error will also be generated if a write protected, unconfigured memory card is present. If that is the case, the write protect switch should be set to off and the card configured using [UTILITY]*[Service][Set-up][Configure Memory Card].*

Memory card write protected

The memory card write protect switch is in the 'on' position, preventing data being written to the card.

Memory operation not permitted

A memory operation is not permitted when the active trace is a "memory only" display. A memory operation may only be applied to a live measurement.

Operation not permitted for active channel mode

The most likely reason for this error is that a GPIB scalar channel command has been sent to the instrument when the active channel is a fault location channel.

Operation not permitted when in source-only mode

A GPIB command has been sent while the instrument is in source-only mode, requesting an operation that is illegal in this mode.

Operation not permitted while display range is zero

Some operations, for instance dB/Octave and dB/Decade, require that the display stop domain is greater than the display start domain.

Operation not permitted while source mode is linear list

Some operations, for instance dB/Octave and dB/Decade, require that the sweep mode must not be linear list.

Operation not permitted with active channel domain

Some operations, for instance bandwidth search and dB/Octave, only work with certain channel domains.
Select a swept frequency source mode.

Operation not permitted with active measurement display format

Some operations, for instance marker search, require that the format be Cartesian. Others, for instance Pk-Pk measurements, Bandwidth Search and dB/, may only be made when a Cartesian log display format has been selected.
Select the appropriate format.

Path cal does not match active channel domain

The active channel domain does not match that stored with the path cal.

Path calibration not permitted when measuring frequency

Path calibration is not appropriate when measuring frequency under swept conditions (i.e. voltage/current sweep). However, measurements may be made relative to a trace memory.

Peak Search is only available for time domain measurements

The peak search command can only be used on a reflection analyzer channel if time domain is enabled.

Percent format not permitted for absolute power measurements

You have attempted to select percent format for a non-relative measurement.
First define a relative measurement.

Pk-Pk measurement not permitted with active measurement display format

Peak-to peak measurements can only be made when a Cartesian log display format has been selected.
Select Cartesian log format.

Plotter not found

The plotter has not been found at the expected GPIB address.
Check plotter GPIB address and cable.

Power meter levelling not permitted when AC Detection enabled

External power meter levelling is not permitted when AC detection is enabled. Internal levelling is selected automatically.

Power meter sensor cal store not available

During power-up, the power meter sensor cal store has been found to be not available because the store is invalid, corrupted or missing (e.g. memory card not inserted). If this happens, the instrument will revert to using the manually entered values of linearity factor and cal factor.

Power meter sensor zero failed

Power meter sensor zeroing has failed, possibly because power was applied to the sensor during zeroing.
Check that the sensor is not connected to a power source.

Power sensor connected to a scalar input (A, B or C)

A power sensor has been found connected to one of the scalar inputs A, B or C.
The power sensor must be connected to Input D, which must be configured to accept the power sensor.

Power sensor not present on Input D

This is a warning that a power sensor is not connected to Input D. This error will occur when the instrument requires that a sensor be present, such as for power sensor cal, source power cal or power reference calibration.

Printer not ready

The printer has been disconnected, is not on line or has run out of paper.
To abort use: [COPY]*[Abort Copy].*

Query DEADLOCKED

This is a GPIB error, and occurs if the MTS is asked to buffer more response data than it has room to store. As query massages are processed, response data is placed in the output queue. If the output queue becomes full, the response formatter has nowhere to store new data, so suspends its operation. The effect of the stoppage propagates back through the system so that eventually the input buffer is no longer serviced, and becomes full. The system is said to have entered the Deadlock State.

When the MTS recognises that deadlock has occurred, the output queue is cleared, the response formatter is reset, and the Query Error bit in the Standard Event Status Register is set (described in Chapter 4). The MTS continues to accept input from the controller, but discards query responses instead of sending them to the output queue. The condition is cleared when the controller sends either Device Clear or a <PROGRAM MESSAGE TERMINATOR>.

Note that the program which caused the deadlock is likely to be still running on the controller. After sending the <PROGRAM MESSAGE TERMINATOR>, the program will very probably attempt to read response data from the MTS. Since the output queue has been cleared, the controller will hang or timeout.

Query INTERRUPTED

This is a GPIB error, and occurs if the MTS is interrupted by a new <PROGRAM MESSAGE> before it has finished sending a <RESPONSE MESSAGE>. In other words, information is requested from the MTS, then not read at all, or only partially read, by the controller.

Query UNTERMINATED

This is a GPIB error, and occurs if the MTS is addressed to talk before a complete query message (including, of course, its terminator) has been sent.

Reflection analyzer calibration invalid

The reflection analyzer calibration has been invalidated because one or more parameters affecting the measurement have changed.
Perform new calibration or recall original conditions using [CAL]*[Recall Cal Conditions].*

Required adapter not present

A GPIB command associated with a particular adapter has been received, but he required adapter is not present.

RF switched off during reflection analyzer measurement

This is a warning that the RF has been switched off and that reflection analyzer measurements are invalid.

Rotary control not available

The front panel rotary control may not be used to adjust the value of the parameter currently enabled for numeric input.

Settings conflict

Generic error indicating that an attempt has been made to make a change that is incompatible with the current instrument state. This error usually only occurs when the instrument is under GPIB control. The most common causes of this generic error are as follows:

Diagnostic commands - source and data acquisition

In general, diagnostic commands are not permitted unless the related diagnostic mode has previously been enabled.

Input D status

If input D is configured to accept a power sensor, that input is not available for measurements where a scalar detector is expected. Similarly, if input D is configured as a scalar detector, commands that assume the presence of a power meter sensor are not allowed.

Live measurements and trace memories

Some commands are allowed only if the active measurement is "live" (i.e. not a trace memory display).

Settings have changed

Recalling calibration conditions may change the instrument settings. If the changes clash with the transmission line database then the database will be turned off.

Smoothing not permitted with active measurement display format

Smoothing is only permitted for cartesian formats. This error is likely to occur only as a result of a GPIB command, and will be generated if an attempt is made to switch smoothing on or change the aperture when the format is not cartesian.

Select a cartesian format.

Software installation card present

User is attempting to format a software options installation card as a stores extensions card.

Software installation memory card not present

This is a warning from the software installation function that the memory card is not a software installation card.

Software option installation aborted

Installation of a software option has been aborted because the card has been assigned to another instrument. The software option may be installed on that specific instrument only.

Software option trial period expired

This message is displayed as a warning that a temporarily installed software option has been deleted following expiry of the allowed evaluation time. The option will no longer be available when the instrument is next powered up.

Source output is pulsed because autozero or AC detection is enabled

This is a warning that the source output will be pulsed because of auto-zeroing or AC detection.

To disable autozeroing use: [CAL]*[Det/Sensor Zero][Detector Autozeroing]*

To disable AC detection use: [MEASURE]*[General Set-up][DC Detection]*

Source set-up has changed

This is warning that the source set-up (frequency range or and/or number of measurement points) has been changed for compatibility with a reflection analyzer channel.

Step keys not available

The front panel step keys may not be used to adjust the value of the parameter currently enabled for numeric input.

System controller passed control at wrong time

This error message indicates that control had been passed from the system controller to the MTS when the MTS was not waiting for control. Control was returned to the system controller.

Trace memory contents incompatible with active channel mode

An attempt has been made to display a trace memory on a channel having a different mode to that which was stored with the trace data.
Ensure channel mode matches trace memory.

Trace memory does not match active channel domain

The active channel domain does not match that stored with the trace memory.

Trace memory has become incompatible with channel domain or type

If a memory is incompatible with the channel it is displayed in then it will not be displayed. This could occur for instance, if two channels of different types are displayed and data is saved to a memory that is in use in the other channel.

Trace memory incompatible with channel mode

A memory may not be usable with a given channel mode. If this is due to the channel mode changing, the memory will not be used (either revert to live measurement or turn memory operation off) and this error given. If it is due to a memory being selected then the memory will not be used and the error given.

Unable to apply path calibration to a trace memory

A path calibration cannot be applied to a trace memory display.

Unable to disable marker coupling

Marker coupling cannot be disabled unless channel coupling is switched off.
First switch channel coupling off: [CHANNEL MODE]*[Channel Coupling].*

Unable to identify detector on Input A (B, C or D)

Type 6511 detector correction assumed;
To change correction applied use: [MEASURE]*[General Set-up] [Detector Correction].*

Unable to lock to external frequency standard

The source has reported that it is not been able to lock to the external frequency standard. The most likely reason for this is that the instrument has not been configured to accept the frequency present at the FREQ STD INPUT/OUTPUT connector.
Check that the signal input to FREQ STD INPUT/OUTPUT *matches the frequency selected using:* [SOURCE]*[Source Functions][Levelling & Freq Std].*

Unable to obtain cal factor frequency from source

For the cal factor frequency to be obtained from the source, channel coupling must be enabled.
First switch channel coupling on: [CHANNEL MODE]*[Channel Coupling].*

Unable to save trace to a trace memory

You have attempted to store a "memory only" trace to a trace memory. Only a live measurement may be written to a trace memory.

Voltage/current output usage has changed

This is a warning that the mode of the voltage/current output has changed. This may affect measurements currently being displayed. If, for example, the mode has changed from voltage sweep to chart recorder mode, any swept voltage measurements will be suspended.

Voltage/current output not configured for chart recorder

This is a warning that the voltage/current output mode needs to be changed in order to use the chart recorder.
To change the configuration use: [SOURCE]*[Source Functions].*

Volts format not permitted

You have attempted to select Volts format when detector correction is enabled.
First disable detector correction: [MEASURE]*[General Set-up][Detector Correction].*

Watts format not permitted

You have attempted to select Watts format for a measurement other than absolute power.
First define an absolute power measurement.

Waveguide sweep not available for active channel mode

Waveguide sweep is only available for fault location and reflection analyzer measurements. The MTS prevents this mode being selected for other channel modes, but the error could be generated as the result of a GPIB command or if the channel mode is changed.

DATA WARNING

Block data error

Generic block data error - either invalid block data or block data not allowed (GPIB only).

Cal kit does not exist

Cal kits are stored on memory cards as well as internal to the instrument. When a reflection analyzer calibration is performed, various data is stored so that when a calibration is next performed, the setup is the same as the last calibration performed. If, when recalling the data for the previous calibration, the cal kit specified is no longer present (the card is removed or another card inserted with fewer cal kit stores), this error will be put up and the cal kit selected will be cal kit 1.

Cannot recall reflection analyzer cal conditions

The cal conditions associated with a calibration cannot be recalled because they exceed the source or power cal limits. This occurs when selecting a calibration or recalling calibration conditions for the current calibration where the frequency or power range of the current instrument is insufficient for the calibration. Note that it is not recommended to transfer calibrations between instruments.

Cannot recall settings

An attempt has been made to recall settings that were saved originally on an instrument with options fitted (and in use at the time of saving the settings) that are incompatible with the current instrument.

Cannot store reflection analyzer settings to settings store

A memory card that has been formatted using an older version of the software cannot store reflection analyzer settings data. The MTS prevents storing or copying of reflection analyzer settings onto those cards.

Character data error

Generic character data error - either invalid character, data too long or character data not allowed (GPIB only).

Command header error

An error was detected in the header. This error message is used when the instrument cannot detect more specific errors (GPIB only).

Data out of range

An attempt has been made to set a parameter to a value outside its permitted range. In many cases the instrument will clip an out of range value so that it lies within its permitted limits, and no error is displayed. For some parameters, however, it is inappropriate to clip the value. (The parameter which sets the number of measurements displayed on a channel is a good example). In these cases this error is generated.

Data overrun when writing store

The amount of data transferred via the GPIB is greater than the size of the destination store. This error will occur when the user's GPIB program has misdirected the contents of the store.
Check that the data transmitted matches the destination store type.

Data type error

The parser recognised a data element different from the type allowed. For example, numeric or string data was expected, but block data was encountered (GPIB only).

Data underrun when writing store

The amount of data transferred via the GPIB is smaller than the size of the destination store. This error will occur when the user's GPIB program has misdirected the contents of the store.
Check that the data transmitted matches the destination store type.

Header separator error

A character which is not a legal header separator was encountered while parsing the header (GPIB only).

Input ordering error

You have entered a start value greater than the stop value or an upper limit value less than a lower limit value.

Insufficient memory to save macro

The macro memory in the instrument or on the memory card is full. This error can occur when copying macros between the internal stores and the memory card. Memory may be freed by deleting one or more macros.

Invalid span

You have entered start and stop frequencies for a narrowband source power cal which results in a span of less than 100 MHz.

Interpolating path cal or trace memory

This is not necessarily an error condition, but a warning to the user that the source set-up of the active channel does not match the conditions (for example start-stop frequency range) that were true at the time the path cal or trace memory data was stored. The stored data will be interpolated to match the channel settings.

Macro does not exist

Entered macro number is out of range. The macro does not exist in internal non-volatile memory, nor can it be found on the memory card.
Ensure that the entered macro number lies within the prompted range.

Missing parameter

Fewer parameters were received than required for the header (GPIB only).

Numeric data error

This is a generic numeric data error, and indicates a problem with data that appears to be numeric, e.g. invalid character in number, too many digits, exponent too large or numeric data not allowed (GPIB only).

Parameter not allowed

More parameters were received than required for the header (GPIB only).

Password incorrect

The password that has been entered is incorrect.

Password invalid

You have entered an out-of-range value when attempting to set up a user-defined password, or when entering a security password.
Valid ranges for passwords are:
Level 1: 1000 to 9999
Level 2: 100000 to 999999
Security: 100000000 to 999999999

Program mnemonic too long

The maximum length for a program mnemonic in IEEE 488.2 is 12 characters. One circumstance in which the limit could be exceeded is if a ":" character is omitted from between the elements of a compound header (e.g. HARDcopyCONFigure instead of HARDcopy:CONFigure).

Stop frequency exceeds waveguide overmode frequency

This is a warning that the stop frequency exceeds the overmode frequency you have entered for the waveguide in use.

Store does not exist

The store number is out of range, i.e. the store does not exist in internal memory, nor can it be found on the memory card, if one is being used.
Ensure that the entered store number lies within the prompted range.

Store empty

You have attempted to recall an empty store.

String data error

Generic string data error, e.g. string contains invalid character or string data not allowed (GPIB only).

Syntax error

An unrecognised command or data type was encountered (GPIB only).

Undefined header error

The header is syntactically correct, but is undefined for this specific device (GPIB only).

OTHER ERRORS

Pk-Pk limit exceeded

Indicates that the marker pk-pk function limit has been exceeded. This error applies to GPIB only and will not result in a displayed error message. However, the pass/fail status is indicated on a form displayed on the screen, as part of the normal operation of the pk-pk function.

Queue overflow

A specific code entered into the queue in lieu of the code that caused the error. This code indicates that there is no room in the error queue and an error occurred but was not recorded. This error applies to GPIB only and will not result in a displayed error message.

Appendix C
FAULT LOCATION MEASUREMENT PRINCIPLES

The following simplified discussion is intended only to acquaint the user with the measurement concept employed, and therefore does not include a mathematical analysis.

A fault in a transmission line will result in a reflection of the signal at the fault location. Observation of the reflected signal at some accessible point (e.g. at either end of the line) allows the determination of the fault location relative to the access point.

To make the above measurement the scalar frequency response of the line is measured , and the time domain response is subsequently computed from the measurements using Fourier Transform techniques.

To generate the frequency response the hardware configuration shown in Fig. C-1 is used. A swept frequency signal is applied to the line via a symmetrical power divider. The input signal power is split into two paths: one is used as a reference, the other is the signal input to the line under test. The signal reflected from the discontinuity in the line is added vectorially at the divider to the reference signal. The scalar analyzer measures the amplitude of the vector addition of the two signals.

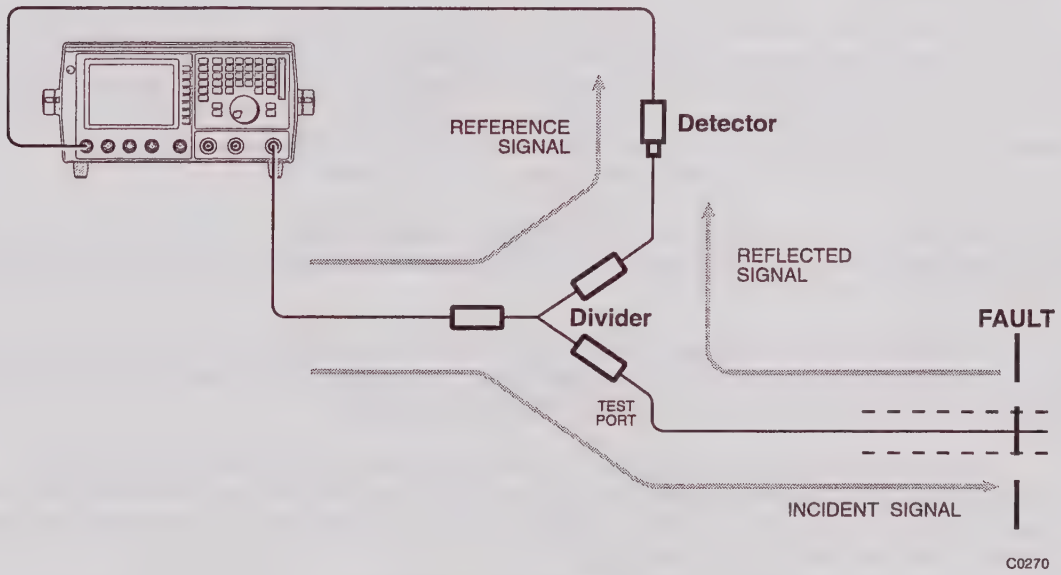


Fig. C-1 Fault Location Measurement System Configuration

To make a fault location measurement, a matched load is first connected to the test port and the scalar response of the power divider is measured. This constitutes calibration and in effect the response of the divider is obtained (i.e. the reference). When the line under test (assumed to have only one fault at the moment) is connected to the test port, its response adds vectorially to that of the divider. The vector addition depends on the phase angle between the two signals at the point of superposition, the centre of the divider. The phase angle in turn depends on the distance between the fault and the divider centre and the frequency.

As the frequency is swept linearly the phase angle changes in a similar fashion since the distance remains constant. Thus the magnitude of the vector sum, which is what the scalar analyzer measures, will vary periodically with frequency and is observed as a ripple (cosine) pattern. The period of the ripple is inversely proportional to the distance between the fault and the divider centre; the ripple amplitude is directly proportional to the reflection coefficient of the fault. Fault location could be extracted manually by measuring the ripple period, but the MTS does this automatically by using Fourier Transform techniques.

When the Fourier Transform is applied to the cosine ripple pattern, an impulse function is obtained in the time domain. This impulse is displaced from the divider centre by an amount dependent on the ripple period, and has an amplitude proportional to that of the ripple pattern. Knowing the velocity of propagation in the transmission line, the location of the fault can be located on a distance scale, which is what is displayed on the analyzer.

The above technique can also provide fault information for a transmission line with several faults. In this case the frequency domain response becomes a complicated ripple pattern which is the superposition of cosine waves having different amplitudes and periods. Visual interpretation would be impossible, but the Fourier Transform method results in the cosine waves transforming to impulse functions which are easily differentiated from each other.

Special features of the fault location measurements

Waveguide Dispersion Correction. In coaxial transmission lines signal velocity is constant at all frequencies. In waveguides signal velocity changes with frequency due to dispersion, i.e. wavelength is not inversely proportional to frequency. This means that as the frequency is swept the period of the observed ripples will change. The result is that the time domain impulses produced by the Fourier Transform are significantly spread, reducing resolution and making interpretation of the display difficult.

The MTS uses a non-linear frequency sweep in order to re-establish the inverse relationship. The required frequencies are generated by the MTS from a knowledge of the waveguide cut-off frequency, which determines the dispersion relationship. This parameter is entered by the operator when setting up a fault location measurement. Using this method, impulse spreading due to dispersion is eliminated at all points along the distance scale. Resolution is therefore maintained and interpretation of the display is easier. This method applies to any single conductor waveguide, such as rectangular, circular or elliptical.

Enhanced Accuracy Mode. The MTS provides an enhanced accuracy mode which gives an optimally interpolated display trace resulting in improved distance and amplitude accuracy, particularly when displaying a sub-range of the distance scale.

Masking Correction. A discontinuity or mismatch in a line can cause an error in the apparent magnitude of a fault beyond it, because the power reflected from the fault is attenuated by two passes through the preceding discontinuity. This leads to underestimates of the severity of distant faults.

The MTS uses a special algorithm to compensate for the effects of reflections due to multiple faults. This is done by special processing of the time data. Each time a peak is identified, the magnitude of the peak is used to calculate the gain which should be applied to all subsequent peaks. As successive peaks are passed, the gain rises to account for the cumulative effect of masking.

Windowing. Because the data is sampled at discrete frequencies and is only available within the system bandwidth, sidelobes are introduced on the fault location display. The sidelobes result in the amplitude of the main peak being reduced, and also provide spurious peaks which can hide smaller reflections, hence limiting the dynamic range.

However, the frequency data can be processed by a method called windowing, so that the severity of sidelobes and amplitude errors is reduced. This can only be done at some cost to resolution, which results in some smearing of the peaks. The MTS allows the user to select one of three windowing levels, which provide different trade-offs between sidelobe height and distance resolution.

Transmission Line Test Head. For ease of use and more reliable measurements, the microwave components necessary for making both return loss and fault location measurements are integrated into a rugged metal housing. The unit comprises a power divider, 3-way power splitter, a return loss bridge and detectors. The return loss bridge is used for making return loss measurements. There is also the 'E' version of the test head which does not contain a return loss bridge.

The Test Head has an input port which connects to the MTS RF output, a test port for making return loss measurements, and a test port for fault location measurements. Both types of measurement require a reference signal for accurate results, and this is achieved via the 3-way power splitter. The power splitter also supplies signal power to the power divider for fault location measurements, and to the return loss bridge. The connectors for the RF input and test ports depend on the frequency range of the unit: N-type and 3.5 mm connectors for 20 GHz and 26.5 GHz versions respectively.

Appendix D
TIME DOMAIN MEASUREMENT PRINCIPLES

Time domain measurements

The following simplified discussion is intended only to acquaint the user with the concepts of time domain measurements, and therefore does not include a mathematical analysis.

With a 6210 Reflection Analyzer adapter fitted, the 6200A MTS has the capability of transforming data from frequency domain reflection measurements into the time domain, enabling measurements of the performance of the device under test (DUT) as a function of time. This provides information about the behaviour of the DUT which could not be obtained through simple frequency measurements. Time domain measurements can be used for:

- Locating discontinuities (points of signal reflection) in the transmission path, relative to a reference plane, usually the input connector of the DUT.
- Identifying the impedance magnitude and type of each discontinuity.

The relationship between the frequency response and the time response of a network or device is defined by the Fourier transform. Because of this relationship the MTS can measure the frequency domain response of a DUT, and then use a mathematical technique (the inverse Fourier transform) to calculate the time domain response, with time as the horizontal display axis. The resulting measurement is the fully error-corrected time domain reflection response of the DUT displayed in near real time.

For fault location measurements, the horizontal axis can be set to display distance, since time and distance are related by the velocity of propagation of the signal in the medium. Response values on the vertical axis can be displayed in several formats, e.g. linear magnitude, log magnitude, VSWR.

The frequency domain reflection measurement of a device is the composite of all the signals reflected by the discontinuities present in the device over the frequency range of the measurement. The time domain measurement shows the effect of each discontinuity as a function of time. These discontinuities, resulting from impedance changes, can be located by selecting the time domain.

Two frequency-to-time transforms are available, low pass and band pass:

Band Pass Mode. In this mode, the MTS mathematically simulates the time domain response to an impulse input, and is used when measuring band-limited devices such as DC blocked cables, waveguides, band pass networks or high pass networks. The band pass mode allows the selection of arbitrary start and stop frequencies, and is easier to use than the low pass mode, which places limitations on the measurement frequency range (see below).

Low Pass Mode. This mode provides the traditional time domain reflectometer measurement capability, and gives the response of a network (mathematically simulated) to either a step or impulse input. The low pass mode provides higher response resolution than the band pass mode for a given frequency domain bandwidth, enabling better discrimination between adjacent impulses. This mode should be used when measuring broadband devices that have a DC path (e.g. cables or attenuators).

In the low pass sweep mode, the frequency data points are harmonically related from DC to the stop frequency, i.e. stop frequency = number of points x frequency interval. Since the lower frequency limit of the 6210 Reflection Analyzer is 250 MHz, the DC frequency response is extrapolated from the lower frequency data. A sweep mode is available (low pass sweep) specifically for use with the low pass transform, and a function is provided which controls the way in which the extrapolation to DC is performed.

With the low pass transform, both the step response and the impulse response provide information about the type of discontinuity (i.e short, open, resistive, capacitive or inductive). However, it is easier to determine the location of a discontinuity if the impulse response is measured. Typical low pass step responses of known discontinuities are shown in Fig. D-1.

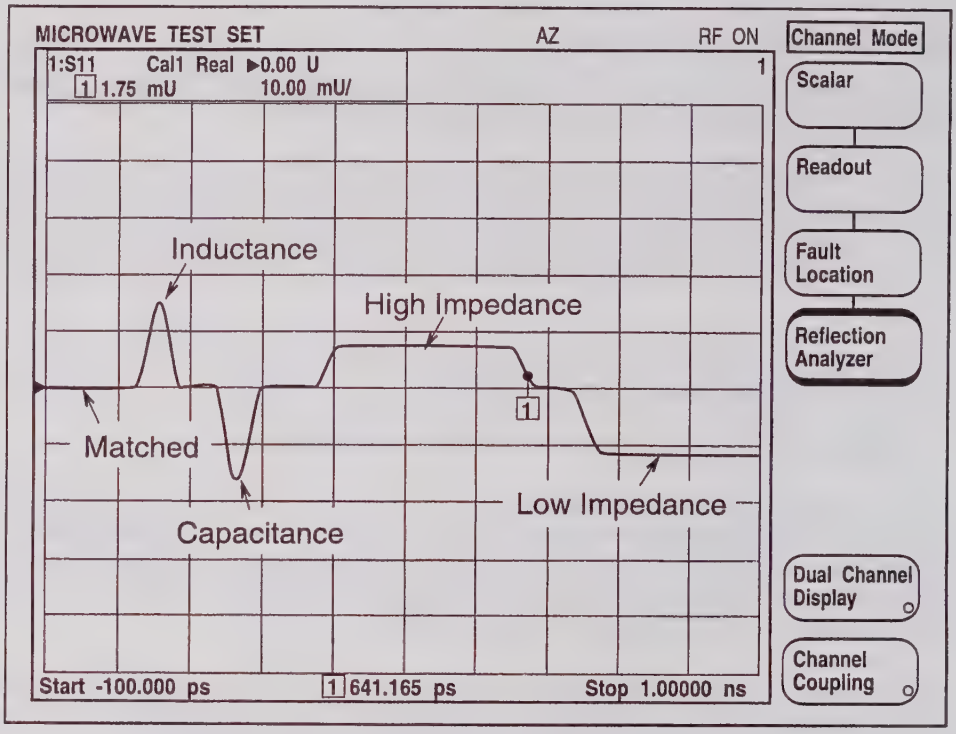


Fig. D-1 Step Response of some known discontinuities

Special Features of Time Domain Measurements

Gating/Fencing. Gating is a facility for mathematically isolating selected time domain responses from the display. The resulting gated time response can then be transformed back into the frequency domain. This provides the facility to view the response of the various parts of a microwave system without disturbing the actual circuit. For example, the time domain responses due to a cable's connectors can be eliminated by positioning a gate around the cable response. On returning to the frequency domain, the display will represent the frequency response of the cable without the connectors. This feature can also be used to remove the effects of unwanted discontinuities in the time domain; on returning to the frequency domain, the frequency response of the remaining discontinuities can be seen.

Fencing is just the inverse of the gating function, in which the responses inside a specified range are mathematically removed. Gating and fencing can be considered as band pass or band stop filters in the time domain, where the start and stop times are the filter -6 dB cutoff times.

In addition to the width of the gate, four different gate shapes can be selected. Different gate shapes affect the degree to which information from one feature in the time domain can be filtered out without affecting the information obtained from a nearby feature.

Windowing. The finite measurement frequency bandwidth transforms to an imperfect impulse stimulus. It has a finite width, and sidelobes either side of the main impulse. The finite width limits the ability to resolve between two closely spaced responses in the time domain. This can only be improved by increasing the frequency span of the measurement. The impulse sidelobes limit the dynamic range of the measurement by hiding low level

responses within the sidelobes of higher level responses. The effects of sidelobes can be reduced by windowing, which filters the frequency domain data prior to converting it to the time domain.

The windowing feature of the Reflection Analyzer allows a trade-off between time domain resolution and sidelobe level. This makes it easier to isolate and identify individual responses when making time domain measurements. Windowing is a mathematical filter function which is applied to the frequency domain data before transformation to the time domain, in order to reduce the sidelobes. The filtering results in low frequency and high frequency data being attenuated, and so features affecting these frequencies are not seen in the transformed data. Hence windowing also results in increased impulse width.

The effect of windowing on the step stimulus is a reduction of overshoot and ringing at the expense of increased rise time. Because of the above effects, various window shapes are available which trade off the degree to which they eliminate sidelobes with the sharpness of the impulse or step stimulus.

A typical time domain measurement procedure is given in the Getting Started Manual for the MTS.

Appendix E
Calibration Kit Handling Precautions

INTRODUCTION

There are a number of calibration kits available for calibrating the 6210 Reflection Analyzer, to cater for measurements in 7 mm, 3.5 mm and N - Type connectors. All types contain delicate calibration pieces, which are manufactured to a higher standard than normal microwave components. It is important to understand and observe the following handling precautions, in order to prolong their useful life and achieve their specified performance. The accuracy of the calibration pieces depends on very precise mechanical dimensions. Tolerances of 1 to 10 µm are typical, with surface finishes better than 0.2 µm. They should therefore be handled more carefully than ordinary components, and always stored with protective connector caps fitted in the foam - lined calibration kit box.

All connectors, on the calibration pieces, on devices under test, and the instrument test port should be gauged regularly. (Note the special instructions below for sliding loads.) It is strongly recommended that every connector be gauged prior to its first use and regularly thereafter, e.g. every 20 connections. Connectors should be visually inspected for dirt, wear or scratches on the mating surface. Connectors become destructively mating with use, and just one connection with such a connector can irreparably damage an instrument test port or calibration piece. Replacement of the damaged item can be expensive and cause lost operating time.

GAUGING

Gauging is a means of verifying that the connector interface parameters are in specification. This is important for two reasons: to avoid damaging the connector and to guarantee performance. Gauging applies to all connectors, and not just those on calibration kit items. Fig. E-1 shows the dimensions of precision N-Type , 3.5 mm and 7 mm connectors.

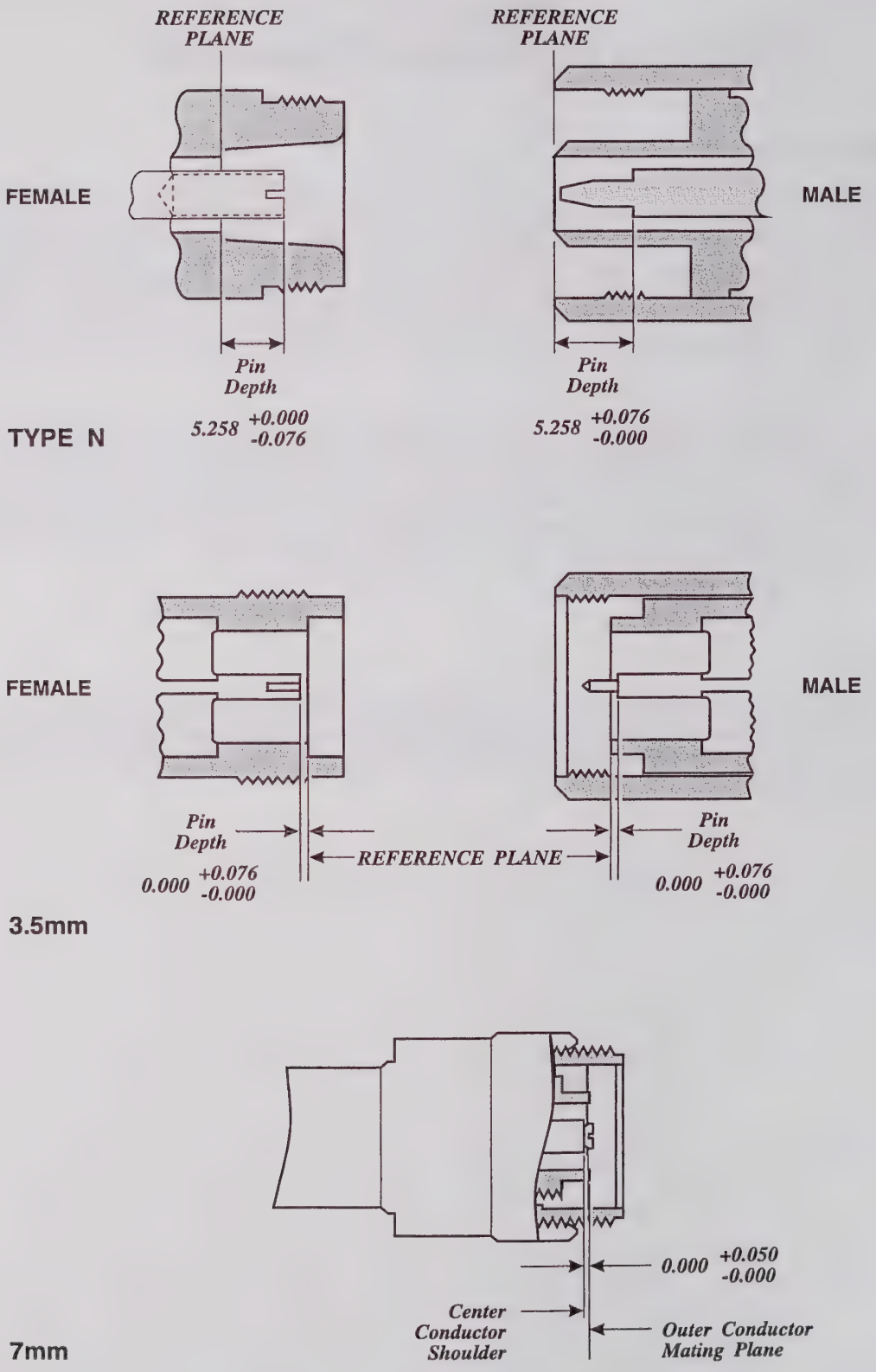


Fig. E-1 Precision connector interface dimensions

Procedure

The gauge should be checked regularly, using the gauge block, for correct zero setting.

(1) Attach the gauge block to the gauge interface and rotate the dial so that the indication reads zero (see Fig. E-2). Some dials have a lockscrew to tighten which keeps the dial in position. Disconnect the gauge block.

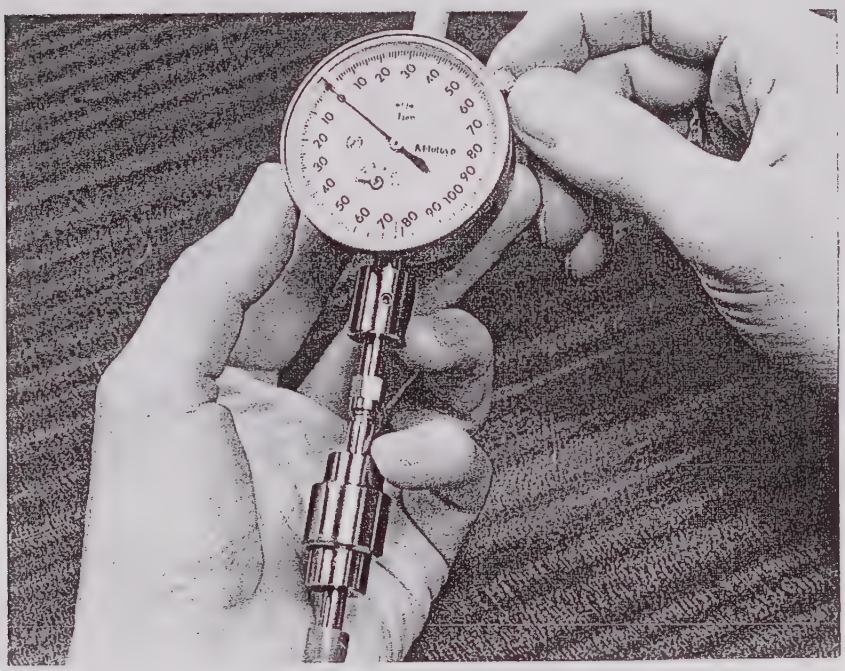


Fig. E-2 Calibrating the dial gauge

(2) The connector to be measured is now mated to the gauge and the indication noted (Fig. E-3).

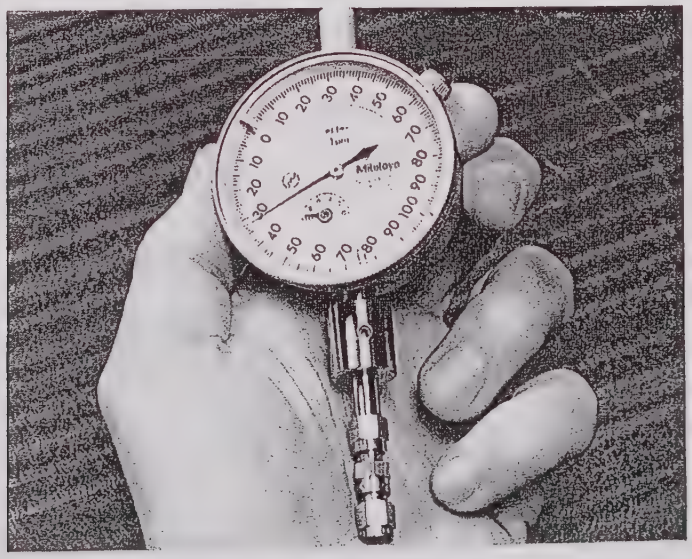


Fig. E-3 Gauging the connector

(3) The connector is "in gauge" if the indication lies between the limits set by the connector specification shown in Fig. E-2. The calibrated zero indication on the dial corresponds to the maximum protrusion of the centre pin. For precision N-type and 3.5 mm connectors the other extreme is -76µm (-0.003 in) (anticlockwise on the dial). For 7 mm connectors, the other extreme is -50µm (-0.002 in).

CAUTION...

Damage to the connector (or the one it is being mated to) may occur if the reading is positive.

(4) After use return the gauge to its box.

CLEANING

Connectors on calibration pieces, devices under test and instruments must be kept clean in order to achieve repeatable and reliable performance. Although there is no standard cleaning procedure, adherence to the following guidelines will assure the degree of cleanliness demanded of microwave and millimetre connections.

CAUTION...

Avoid any type of solvent coming into contact with the centre conductor support bead, since some beads react with some solvents.

Procedure

(1) A small can of compressed air (the type sold for dusting electronic components and assemblies) is useful for preliminary cleaning of connector interfaces. Spray the gas over the exterior and interior connector surfaces. This serves to dislodge any surface dust prior to visual inspection.

(2) Visually inspect the connector surface for dirt and dullness. Pay particular attention to the outer conductor mating interface. If possible use a 2X or 3X magnifying glass. If the connector satisfies this visual inspection no further cleaning is required.

(3) Exterior:

Although the connector exterior does not in itself contribute to the electrical performance, it should be kept clean in order to reduce the possibility of internal contamination.

Dampen a lint free cloth with Isopropyl Alcohol (IPA) solvent and firmly wipe the connector exterior surface until all dirt is removed. Pay particular attention to the threads on female connectors as dirt may inhibit mechanical mating. **Do not apply IPA directly onto any part of the connector.**

(4) Interior:

Wrap an IPA dampened lint free cloth round the wooden applicator and firmly wipe the outer conductor mating interface as shown in Fig. E-4. Avoid contact with the centre conductor during this action.

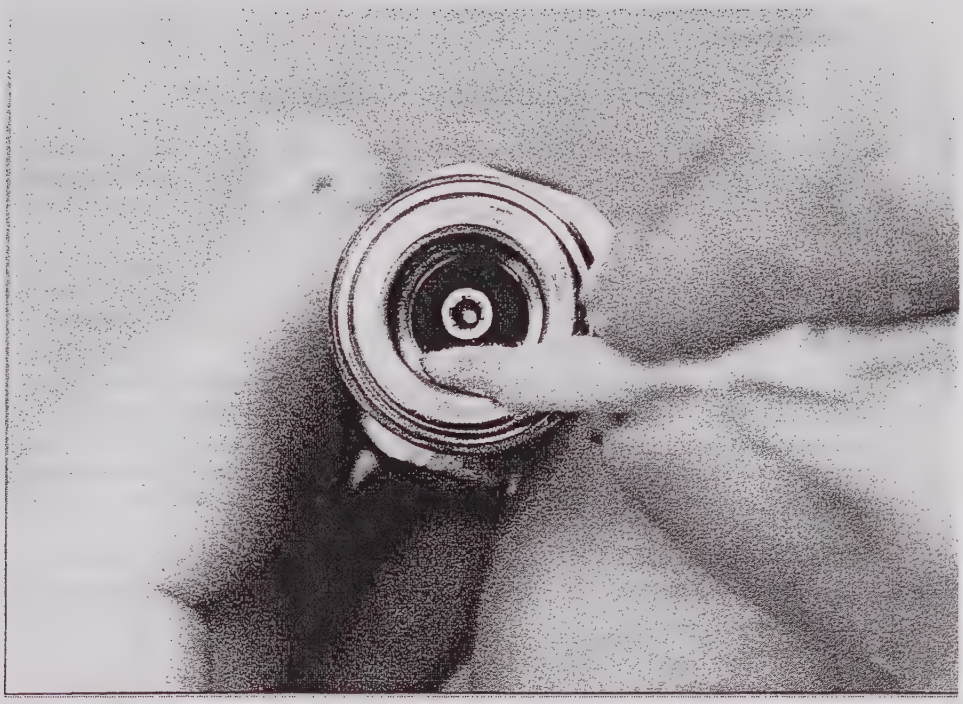


Fig. E-4 Cleaning connector interior

The centre conductor and its pin or collet should not require any cleaning other than by the use of compressed gas. In the unlikely event that they do, a very gentle wiping action should be employed to avoid damage.

(5) Apply compressed gas to all connector surfaces to ensure evaporation of the solvent.

HANDLING OF FIXED CALIBRATION PIECES

(1) When not in use, connectors should be covered with plastic dust covers and calibration pieces stored in the calibration kit. This keeps them clean and protects the internal mating surfaces from damage.

(2) Always use the correct mating techniques.

For sexed connectors (N - Type and 3.5 mm), the two connectors to be mated should be pressed together such that the pin penetrates the collet prior to the nut being tightened. Never rotate one connector body relative the other because this wears out the mating interfaces, thus reducing connector lifetime. Furthermore, any slight non-visible eccentricity of pin or collet is more likely to cause damage.

For 7 mm connectors, arrange for the thread to be fully extended on the test port and fully retracted on the calibration piece or device under test. Adopting the same convention for terminations and other components will avoid some connectors accidentally undoing while torquing up. Do not tighten up the loose nut on a mated pair of connectors - this only serves to reduce the contact pressure and degrade the connector performance. The counter - rotation technique can be used for better connector repeatability at the expense of increased connector wear. This involves a small rotation of the connector body just before the nut is fully tightened.

(3) Avoid over-torquing connectors during mating. The torque wrenches in use should be verified on a regular basis.

(4) Do not use connectors as mechanical support for heavy components.

(5) Never use a connector whose pin or collet is destructively "out of gauge". Either return the component to its manufacturer for repair or discard it. The same applies to connectors whose centre conductors are loose or visibly eccentric with respect to the outer conductor.

HANDLING OF SLIDING LOADS

(1) Always move the slider to the position nearest to its connector before making a connection, because this offers maximum centre conductor support. Sliding loads should be connected first to a connector gauge and the centre conductor adjusted to the calibrated zero indication on the dial. Then, the sliding load can be connected to the test port as if it had a standard connector. Make sure that the centre conductor locates properly with the test port centre conductor.

(2) When not in use, connectors should be covered with plastic dust covers and the sliding loads stored in the calibration kit. This keeps them clean and protects the internal mating surfaces from damage.

HANDLING OF AIRLINES

(1) Airlines are stored in two parts - the outer conductor (tube) is protected with plastic dust covers, and the inner conductor (rod) is stored in a plastic tube. Never touch the inner conductor with bare hands since sweat from fingers causes accelerated tarnishing of the gold plated surface. Always wear lint - free gloves, finger cots, or handle the centre conductor through a lint - free cloth.

(2) Carefully insert the centre conductor into the outer conductor. In the case of sexed connectors, mate the female end of the airline first. Otherwise, it is preferable to mate the test port end first. Locate the centre conductor and then slide over the outer, completing the connection only finger-tight at first.

(3) If the other end is male, retract the nut as far as possible, and delicately locate the centre contact before bringing the outer conductors together. At this stage it is useful to glance at the measurement response, because resonances or glitches in the trace may indicate a misplaced centre pin.

(4) Only torque up the connectors when you are sure that the airline has been correctly assembled.

(5) Disassembly also requires care. Start furthest from the test port, undoing only one connector at a time. Withdraw the centre conductor completely if it remains attached to the removed connector.

(6) Keep the connectors on - axis all the time, since any skewing can force the collet fingers to open up permanently.

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